LUMBERING AND WOOD-WORKING INDUSTRIES

IN

THE UNITED STATES AND CANADA

TOGETHER WITH

NOTES ON BRITISH PRACTICE AND SUGGESTIONS FOR INDIA

BASED ON

A TOUR IN NORTH AMERICA IN 1918

BY

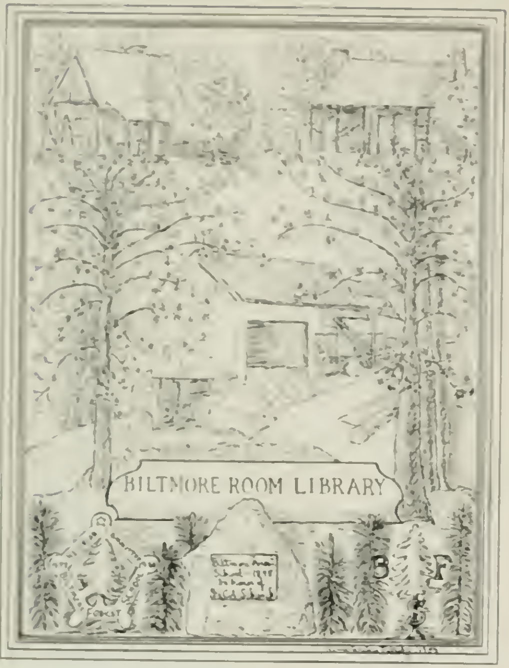
F. A. LEETE
Imperial Forest Service, India.

IN THREE VOLUMES.

VOL. I.—LOGGING.

24
2498

SIMLA:
PRINTED AT THE GOVERNMENT MONOTYPE PRESS
1919.


BILTMORE ROOM LIBRARY
Forest
B F S

Presented to

THE BILTMORE ROOM
North Carolina State College
School of Forestry

By Milton K. Lockwood

Biltmore Forest School, Class of 1913

Date April 26. 1957

LUMBERING AND WOOD-WORKING INDUSTRIES

IN

THE UNITED STATES AND CANADA.

TOGETHER WITH

NOTES ON BRITISH PRACTICE AND SUGGESTIONS FOR INDIA.

IN THREE VOLUMES.

Vol. I .. .. Chapters I to VI—Logging.

Vol. II .. .. Chapter VII—Sawmills.

Vol. III .. .. Chapters VIII to XIV.—Economic Forest Research, Wood-working industries, such as Barrel-making, Plywood, Matches, etc. and a chapter on the Water Hyacinth.

231R&A

Digitized by the Internet Archive
in 2010 with funding from
NCSU Libraries

http://www.archive.org/details/lumberingwoodwor01leet

VOL. I.

TABLE OF CONTENTS.

PART I.—LOGGING.

INTRODUCTION.

		Page.
Chapter	I.—Description of the Forests · operations visited ..	8
,,	II.—Logging Railways	12
,,	III.—Skidding of Logs by Steam Power	24
,,	IV.—Loading and Unloading of Logs on Rail	47
,,	V.—Log making, Animal Hauling and Road Transport ..	55
,,	VI.—Floating and Rafting of Timber	58

List of Plates in Volume I.

Plate.	Title.	Paragraph.
I	Overhead Skidding Rig with Lidgerwood Slack-puller	*Frontispiece.*
II	Index map of Tour	Intro. 2
III	(1) Canal and Raft in Cypress Swamp, Donner, La.	6
	(2) Pull-Boat at work in Cypress Swamp, Donner, La.	6
IV	(1) Dredging Canal in Cypress Swamp, Terre Bonne, La.	6
	(2) Ground Skidding in Cypress Swamp, Donner, La.	6
V	(1) Railway track in Cypress Swamp, showing ballasting with mill refuse, Lutcher, La.	6
	(2) Switch-backs and Log train on 3 ft. track, Lamoine, California	8
VI	(1) Trestle and Log train,—Townsend, Tenn.	8
	(2) Slip-joints on long grades,—Townsend, Tenn.	9
VII	(1) Switch-back and trestles,— Townsend, Tenn.	9
	(2) Trestle, 240 ft. long and 150 ft. high, 3 ft. track, Elk, California	10
VIII	(1) Trestle and log train on 3 ft. track, Elk, California	10
	(2) Logging railway in the plains, Buna, Texas	11
IX	(1) Skidder at work in Cypress Swamp, showing rough character of the spur line,—Ware, Georgia	11
	(2) Trestle across Swamp—New Bern, N. C.	11
X	(1) Cable Railway or incline ; special car for cable, Arlington, Wash.	17
	(2) Hoisting Engine at top of Incline, Arlington, Washington	17
XI	(1) Excavation of railway track by Marion Steam Shovel, Elk River, Idaho	18
	(2) Track cleared by Shovel, Elk River, Idaho	18

List of Plates in Volume I—contd.

Plate	Title.	Paragraph.
XII	(1) Shovel mounted on road wheels	18
	(2) Shovel mounted on Caterpillar wheels	18
	(3) Shovel mounted on railway track	18
XIII	(1) Boom skidder mounted on a railway car loading sleepers, Tyson Creek, Idaho	19
	(2) 70 ton Shay geared Locomotive	20
XIV	(1) Russell Skeleton Logging Car	21
	(2) Russell Short Flat Car	21
XV	(1) Wood rail tramway; log being loaded by parbuckling, *vide* paragraph 63,—Overton, Tenn.	24
	(2) Prevention of cattle trespass at Railway crossing	24
XVI	Diagrammatic view of Ground Skidding and Loading on rail ..	26
XVII	(1) Long distance hauling with "Road" engine in B. C.	27
	(2) Diagrammatic view of "Ground" Skidding, using Baptist cones, *vide* paragraph 45	29
XVIII	Overhead Skidding, 3,000 ft. span, Townsend, Tenn.	30
XIX	(1) *Overhead Skidding.*—Span 1,200 ft., nose of log well off the ground—Lake Cowichan, B. C.	30
	(2) *High Lead Skidding.*—Head spar tree in the centre, mechanical outhauling, strip of forest being logged on the left; loading on the right, — Keeler, Idaho	30
XX	High Lead Tree Spar Skidding and Guy Line Loading	31
XXI	*High Lead Skidding.*—Cutting the top off a head spar tree, 180 ft. above the ground	31
XXII	(1) Intermediate support of 3,500 ft. Overhead Rig; log just passing, —Keeler, Idaho	31
	(2) Same as above at railway end of operation;—Keeler, Idaho ..	31

List of Plates in Volume I—contd.

Plate.	Title.	Paragraph.
XXIII	(1) *Relay Skidding*; diagrammatic section	31
	(2) *Relay Skidding*; plan showing the successive positions of the relay and tail trees round the setting in the middle	31
	(3) Timber skids for skidder ;—Fort Bragg, California	32
XXIV	(1) Skidder mounted on timber skids hauling itself off a railway car at a new setting ;—New Westminister, B. C.	32
	(2) Transporting skidder by rail on 3ft. track,—Lamoine, California	32
XXV	View of a setting after completion of logging	36
XXVI	(1) 2-Drum ground skidder, purchased by the Forest Department, Burma in 1913	38
	(2) Lidgerwood Overhead skidder, lowering steel spartype, with swinging loading boom	38
XXVII	Clyde Overhead Skidder showing logs being piled below the railway track,—Townsend, Tann	40
XXVIII	(1) Overhead Skidder in Cypress Swamps, Lutcher, La.	40
	(2) Logging in the Gigantic Redwood Forests of California. Fort Bragg, California	40
XXIX	(1) Willamette Boom Skidder and Loader; 3 ft. track—Lamoine, California	42
	(2) Skidding with Cones: Sardis, Mississippi	45
XXX	(1) Ordinary type of Overhead Skidding Rig	46
	(2) Lidgerwood Slack-pulling Overhead Skidding Rig	46
XXXI	(1) General type of Gearing of Skidding machines	47
	(2) Lidgerwood interlocking Drum type of Gearing of Skidding machines	47
XXXII	(1) Sky Line Skidding and Loading :—Elk, California	49
	(2) Same as above, near view after the log had been deposited on the car, Elk, California	49

List of Plates in Volume I—contd.

Plate	Title	Paragraph.
XXXIII	(1) Macfarlane (Sky line) system with single overhead cable ..	49
	(2) Macfarlane (Sky Line) system with double overhead cable ..	49
	(3) North Bend Overhead Skidding system	50
XXXIV	Example of very good logging in National Forest : Lamoine, California	53
XXXV	Line drawings of Skidding tongs, Choker Hook and Sling ; and methods of attachment of logs for loading	60
XXXVI	(1) Parbuckling by steam power ; 3ft. track :—Bridal Veil, Oregon	63
	(2) Two-legged Gin Pole ; 80 ft. long,—Elk, California	64
XXXVII	(1) Portable Gin Pole on Snow Sled—River Marnie, Quebec ..	64
	(2) Gin Pole Loading from water,—Lake Cowichan, B. C. ..	64
XXXVIII	(1) Single Guy Line Loading,—New Bern, N. C.	64
	(2) Double Guy Line Loading in combination with High Lead Skidding in Douglas Fir Forest,—Myrtle Point, B. C. ..	65
XXXIX	(1) Sky Line Skidding and Loading in a single operation (see also plate XXXII). Elk, California	65
	(2) Tree Spar Boom Loader	67
XL	(1) McClean Tree Spar Boom Loader ;—Wind River, Washington ..	67
	(2) Same as above ; counterpoise log running on Guy Line shown to the left :—Wind River, Washington	67
XLI	(1) Fixed Boom machine mounted on car loading pulp wood, double track :—Madawaska, Ontario	68
	(2) Surry Parker Loader, empty car passing through :—New Bern, North Carolina	68
XLII	(1) Old type of Lidgerwood Swinging Boom Loader mounted on a timber platform jacked up over the Railway track.—Sardis, Mississippi	68
	(2) Same as above, showing near view of wood blocks supporting the platform.—Sardis, Mississippi	68

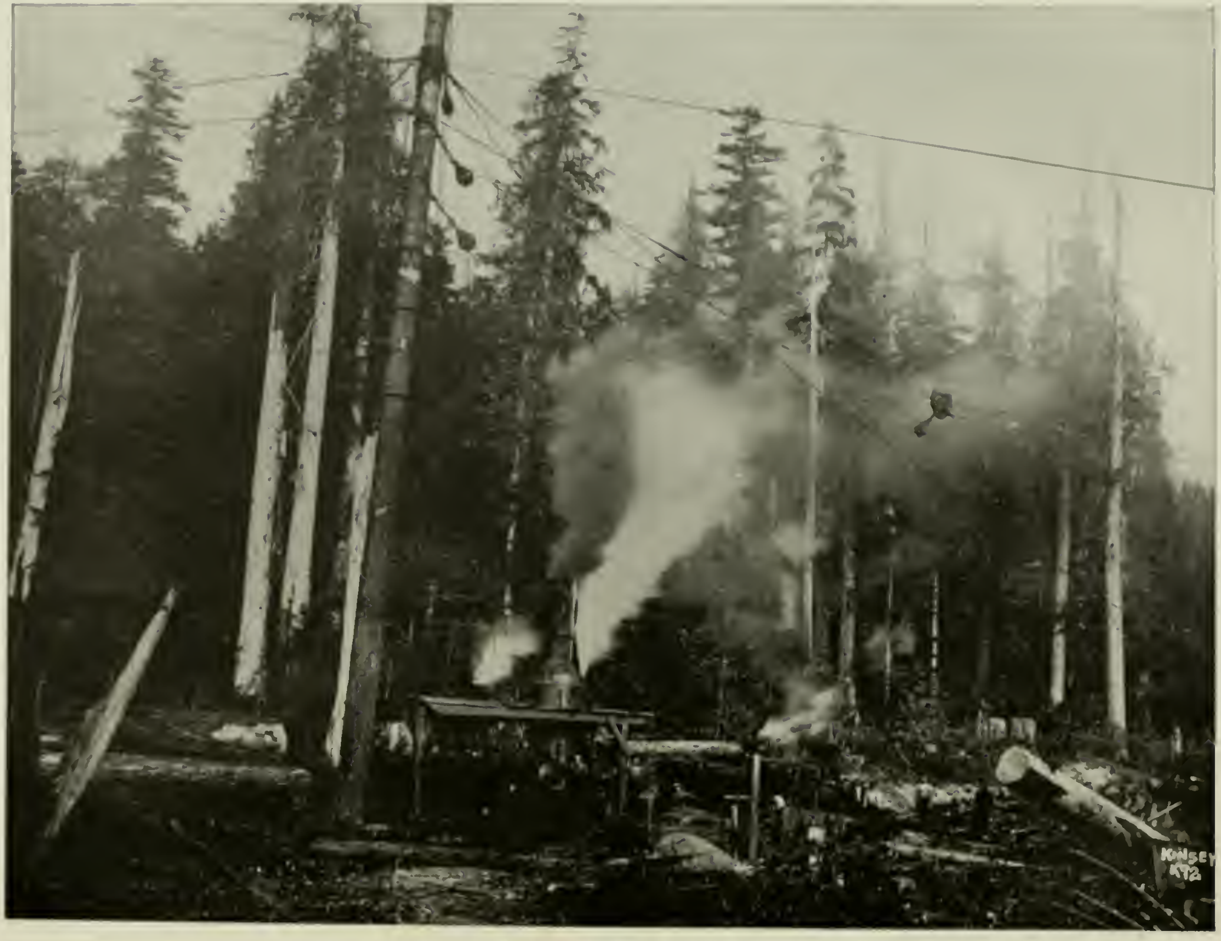
List of Plates in Volume I—contd.

Plate.	Title.	Paragraph.
XLIII	" American " Log Loader	68
XLIV	(1) Lidgerwood latest type of Combined Skidder and Loader (see also plate XXVI) :—Kapowsin, Washington	68
	(2) Dumping logs from cars into San Juan River B. C.	70
XLV	Line drawings of Peavey and Cant Hook	71
XLVI	(1) Use of Peavies in loading logs	71
	(2) Undercutter	72
	(3) Tree faller	73
XLVII	Gasoline Drag Saw	74
XLVIII	(1) Parbuckling logs into piles for transport by Big Wheels,—Weed, California	79
	(2) Same as above, Slip Tongue Big Wheels in position ready for hauling,—Weed, California	79
XLIX	*Big Wheels of the Fixed Load type.*— (1) Axle lever being tied to the logs :—Flagstaff, Arizona ..	79
	(2) Same as above ; 4 horses hauling 3 tons of logs on fairly level but rough ground :—Flagstaff, Arizona	79
L	(1) Benson Raft ready for Sea, 8,000 tons of logs	81
	(2) Benson Raft under construction showing upper part of cradle ..	81
LI	(1) and (2) Views of Davis Raft :—2,000 tons of timber, Vancouver, B. C.	81
LII	(1) Benson Raft under construction	82
	(2) Benson Raft completed, cradle removed	82
LIII	Diagram showing method of construction of Davis Rafts	83
LIV	(1) Splash Dam from below, —Wind River, Washington	86
	(2) Splash Dam raising water level 35 ft. :—Blount Country, Tenn.	86

List of Plates in Volume I—concld.

Plate.	Title.	Paragraph.
LV	(1). Lower end of a flume bringing sawn timber from Mill to railway :—Lamoine, California	87
	(2). Flume for logs up to 2 ft. in diameter :—Addie, Idaho.. ..	87
LVI	Ordinary type of raft being towed near Vancouver, B. C.	88

Plate I.



Overhead Skidding rig with Slack puller.
(Presented by Messrs. the Lidgerwood Manufacturing Co.)

[Frontispiece.

VOL. I.

LOGGING.

INTRODUCTION.

On several occasions I expressed the hope to Canadian and American Foresters and Lumbermen that many other officers from India might be privileged to enjoy the unique experience accorded to me.

This was no empty compliment but the expression of a sincere conviction resulting from that experience. It would pay to give a considerable number of officers in the Forest Department a first-hand knowledge of conditions in North America. The Government of India might well show its appreciation of good work and meritorious service by selecting two or three officers annually for deputation on their way, to or from, home on leave. Such a concession would be highly prized. Moreover, interchange of visits between Forest Officers would be one step towards further cementing the bonds of union between the two countries.

As the report itself shows I could not do more than acquire a superficial knowledge of many of the subjects touched upon. Coupled with this is the fact that visits to only twenty-seven lumber camps and about the same number of special works could not possibly have exhausted the field for study, seeing that there were thousands to choose from. Assuming, therefore, that there is plenty of scope for further investigation, and permitting other officers to take part in the enquiries, the additional facts brought to light should result in a better perspective being attained.

Not only would the adoption of the above suggestion enable the Forest Department in India to keep up-to-date with further developments, but it would also be a good way of *keeping in touch with manufacturers*. I look upon this as a matter of great importance if any large purchases of machinery are likely to be made in America. It is my experience that nothing puts business men off more than being approached in person—and more so by correspondence—by men without a fairly good general idea of the matter under reference, or of the particular line the business-men are themselves concerned with. For this reason alone I recommend that at least one fairly senior officer *with the requisite qualifications* be sent annually to America, and that the actual placing of orders for machinery be, within limits, left to his discretion.

It is, indeed, not only in respect to lumbering and wood-working industries that interesting developments are constantly taking place in the Western World. The virile growth of the United States Forest Service is also remarkable. It was a source of great regret to me that I could not find many opportunities for meeting Canadian and American Forest Officers, or for making special visits to forests of interest silviculturally. I learnt sufficient, however, to convince me that study of such forests would be distinctly useful to Foresters in India.

Diary of tour.

2. My stay in North America covered a period of a little over five months. I landed at New York on 20th February, and I left it on 30th July on my way back home.

I proceeded first to Ottawa, in order to arrange details of my tour in Canada with Mr. R. H. Campbell, Director of Forestry to the Dominion of Canada. Before turning southwards I paid two short visits to lumber camps, one near Ottawa and the other in Eastern Quebec, to give me some idea of working under snow conditions. On my way south I halted at New Haven to discuss details of my tour in the States with Professor Bryant of the Yale Forest School, to whom I had been recommended by the authorities at Washington.

A week was spent at Washington studying records and collecting information. I left there on 17th March for a lumber camp in North Carolina and, in the course of the next five weeks, visits were paid to eight lumber camps in the Eastern and Southern States. I also looked into the Water Hyacinth problem in Florida and Louisiana, and saw a turpentine operation in Texas. A week was taken up with crossing to San Francisco, including halts at Flagstaff (one camp) and the Grand Canyon.

It took four weeks to visit nine camps in North California, Oregon and Washington. A fortnight was spent in British Columbia and four days in Idaho.

Crossing Montana, Dakota and Minnesota took four days steady travelling. After visiting Duluth I had three interesting days at the Madison Laboratory. With halts at Chicago, Detroit, Buffalo, Niagara, Hamilton, Brantford, Toronto and Longford it took a week to reach Ottawa.

In the course of the next week the Montreal Laboratory and Syracuse University were visited and New York was reached on 7th July. Subsequently, a lumber camp was visited in West Virginia and three days occupied at Washington in saying goodbye to the Heads of the Forest Service. The rest of the time (11 days) was spent in New York interviewing manufacturers, getting passports, collecting baggage, etc.

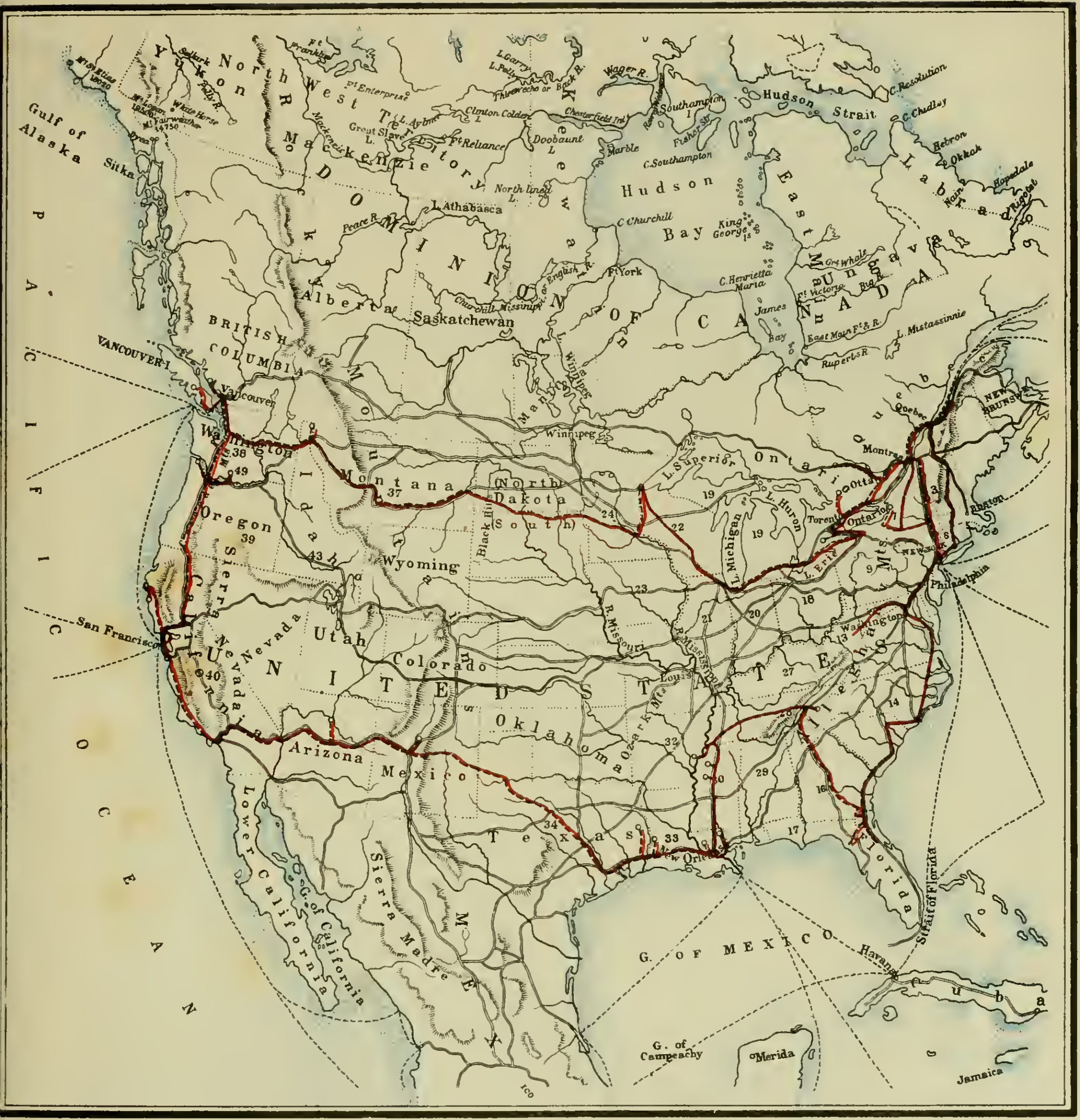
Distance travelled.

3. In the course of the tour of five months I travelled 16,871 miles on open lines, 492 miles on logging railways and 1,082 miles by motor trolley, car or launch; total, 18,445 miles, besides journeys in towns and cities. 32 whole nights were spent in train or steamer. The only places with halts of more than four days were Washington, San Francisco, Portland and New York. Everywhere I found matters of sufficient interest to occupy my time fully and towards the end I was distinctly tired. The tour might very well have been extended to nine months for more detailed study of the operations actually visited, and then it would only have enabled me to see one or two examples amongst scores of a similar character.

Each visit to an operation generally included an hour or two in a mill. In addition, special visits to other mills and manufacturing plants were made.

Part of the machinery used on the Pacific Coast is made on that side of the Continent. The manufacture of the rest of it, and also of the greater portion of the machinery of all kinds used in North America, is concentrated in the Lake States and Ontario. Most of my time in the last month was taken up with getting into

Plate II.



INDEX MAP OF TOUR

ABBREVIATIONS FOR NAMES OF STATES REFERRED TO IN THE REPORT.

3.	Vermont	Ver.
5.	Rhode Island	R. I.
6.	Connecticut	Conn.
7.	New York	N. Y.
9.	Pannsylvania	Pa.
13.	West Virginia	W. Va.
14.	North Carolina	N. C.
16.	Georgia	Ga.
17.	Florida	(Fla).
18	Ohio	Ohio.
19.	Michigan	Mich.
20.	Indiana	Ind.
21.	Illinois	Ill.
22.	Wisconsin	Wisc.
23.	Iowa	Iowa.
24.	Minnesota	Minn.
27.	Kentucky	Ky.
28.	Tennessee	Tenn.
29.	Alabama	Ala.
30.	Mississippi	Miss.
32.	Arkansas	Ark.
33.	Louisiana	La.
34.	Texas	Texas.
37	Montana	Mont.
38.	Washington	Wash.
39.	Oregon	Ore.
40.	California	Calif.
43.	Idaho	Idaho.
49.	District Columbia	D C.

touch with manufacturers themselves. I paid many visits to individuals. They were distinctly useful, not only in extending my own knowledge but also in helping firms to understand what Indian conditions are like and what Indian requirements may be in the future.

Acknowledgments.

4. The reception met with everywhere was cordiality and kindness itself. I am filled with a deep sense of gratitude to all the gentlemen with whom I came in contact. The United States Forest Service, the Dominion Forest Service, and the British Columbia Forest Service placed all their resources at my disposal and spared no pains to give me all possible assistance and information. It was the same in the various lumber camps, mills, factories and training schools visited: everywhere a most kindly reception, every assistance to see the operations and a cordial invitation to stay longer and come again.

The shortness of my stay at each place was a frequent source of regret to me. I should have liked to have had more time in which to answer the eager questions about life in India. I often regretted not having brought a good collection of photographs and lantern slides with me. Stories of life in India, and especially of such subjects as logging with elephants, were a never failing subject of interest to lumbermen.

5. There are two gentlemen to whom I desire to express special thanks, Mr Ralph C. Bryant, Professor of Lumbering at The Yale Forest School and Mr. Geo. M. Cornwall, Editor of the "Timberman", Portland, Oregon.

I was very fortunate in being able to meet Mr. Bryant more than once, first at the commencement of my tour, later on in the South after I had been to some operations, and again at the end of the tour. Discussion of my impressions with the Professor was of great value.

The frequent references in my report to Mr. Bryant's text-book "Logging" (published in 1914) show how very useful the book was to me. Copies of it —or better still of a revised edition up-to-date and more suitable for readers in India —should be in every Forest library. It would be a graceful acknowledgment to Mr. Bryant to invite him to India to write a revised edition himself. In this connection it may be mentioned that Mr. Bryant is acquainted with lumbering conditions in the Phillippines, as he has seen service there.

Before leaving England I was recommended by an officer in the Canadian Forestry Corps to get into touch with Mr. Cornwall as soon as possible after my arrival in America. I was fortunate in being able to do so personally at Washington before leaving for the South. Mr. Cornwall knows everybody in the lumber world on the Pacific Coast, and his introductions made me welcome everywhere. The "Timberman" is a paper with a wide circulation and great influence.

Reasons for short stay in Canada.

6. My instructions being to study lumbering both in Canada and in the United States, at first sight it may appear surprising that I gave less than a month to the former. This was because Canada is far behind the States in matters likely to be of interest in India in respect to logging and wood manufacture. The fact that logging in Eastern Canada is done under snow conditions more or less rules it out altogether.

In British Columbia I saw practically nothing that I had not already seen in the States of Washington and Oregon. If my tour had been started from the West—as would be the case with anyone coming direct from India—I should naturally have stayed longer in British Columbia, but even there the greater part of the logging and mill machinery comes from the States.

Many of so-called Canadian firms are simply branches of parent firms in the United States. It is also a common practice to import parts of machines from the States and merely to assemble them in Canada.

A considerable quantity of sawmill plant is made in Ontario and a certain amount of logging machinery in British Columbia and Eastern Canada, but for manufactures such as veneers, cooperage, creosoting, etc., all supplies come from the States.

Technical terms.

7. There is such a complete vocabulary of technical terms peculiar to America that it takes time to become familiar with them. Some are used freely in this report, as they have no good equivalent in use in England or India. A few examples may be given.

- "*Logging*" is a general term for all operations connected with the preparation of logs in the forest and the transport of them to mill or sale depôt.
- "*Lumbering*" is still more comprehensive and also includes rough (*i.e.*, unplaned) sawing in the mill. "Lumber" itself means rough converted timber, whether cut to stock sizes or not. It is not applied to dressed or planed timber.
- "*Skidders*" are machines for hauling logs, the operation itself being generally spoken of as "Skidding" or "Yarding".
- "*Stand*" is a rather inelegant phrase for the amount of merchantable timber in a forest. It is, therefore, not exactly equivalent to "Growing Stock."

The above terms, as well as others such as "Hardwoods" (broad-leaved species) and "Softwoods" (conifers), are so well known and universally used that I make no apology for recommending everybody in India to make themselves familiar with them.

The term "Board Feet" is so widely used that a short description of American methods of measuring timber is given below, although I have no desire whatever to suggest the adoption of the methods in India.

The "Board Feet" in a piece of timber is the number of running feet of sawn timber 12" wide and 1" thick contained in it.

In the case of sawn timber it is usually sufficient to divide B. F. measurements by 12 to convert them into cubic feet.

In the case of logs it is not so simple a matter. Two things have to be remembered. In England measurements are based on girth *at the middle*, whilst in America they go by the *thin end* of a log. A set of tables cannot therefore be readily converted by calculation with a single factor. The other point is that there is no standard method used by everybody in North America in the same way that the "Hoppus" rule is used in England.

There are several " Log Rules " in America, all giving different results. The underlying idea in log measurements, both in England and in America, is not to record the absolute contents of a log, but merely the quantity of sawn timber it is expected to yield. In neither case do the figures tally with the actual measurements of lumber *after sawing*. In England log measurements are anything up to 25 per cent. too large; but in America it is just the opposite, log measurements being anything up to 25 per cent. smaller than the mill output.

For the purposes of this report it is sufficiently accurate to assume that 10 B.F.= 1 cubic foot.

Publications.

8. A large number of papers devoted to lumbering and to wood manufacture are published in North America. They contain a good deal of useful information from time to time as to developments in methods and machinery. For example, by the courtesy of the Editor, the writer was supplied with a whole series of cuttings from old files of " The Timberman " illustrating and describing most of the methods of skidding devised up to date. In the same paper attention has recently been invited to a machine which has not yet been brought out, namely, a self-propelling skidder mounted on caterpillar wheels.

LIST OF PUBLICATIONS.

United States of America.

The Timberman, Portland, Ore.
The American Lumberman, Chicago, Ill.
The Hardwood Record, Chicago, Ill.
The West Coast Lumberman, Seattle, Wash.
The Lumber Trades Journal, New Orleans, La.
Barrel and Box, Chicago, Ill.
Veneers, Indianapolis, Ind.
Coopers Journal, Philadelphia, Pa.

Canada.

The Canadian Lumberman, Toronto, Ont.
The Canadian Woodworker, Toronto, Ont.
The Pacific Coast Lumberman, Vancouver, B. C.

Summary of the Report.

Summary of the Report.

9. My report on Lumbering and Wood-working industries was originally drafted in four parts, namely :—(*i*) Logging, (*ii*) Milling and Manufacture, (*iii*) Research, (*iv*) Water Hyacinth, all to be published in one volume. It was afterwards decided to print the report in three volumes as nearly as possible equal in size. The subdivision into the four " parts " was therefore dropped.

The great length of the report is partly due to a desire to give in full the data on which recommendations are based, and partly to the idea that the detailed description of logging and manufactures would be of general interest and of permanent value. Even if Western methods and appliances are not at once widely adopted in India, it cannot but be good for all forest officers to know something about them.

British Practice.

Readers of the report should not overlook the fact that it is primarily descriptive of Western methods and appliances. The time at my disposal was so limited that a similarly exhaustive description of British practice was out of the question and all I could do was to try and include details of importance with regard to sawmills and manufactures. It was indeed fortunate that I did look into matters to some extent at home, for more than one of the impressions formed in America was found to stand in need of correction.

Volume I.—Logging (Chapters I to VI).

10. It is a comparatively simple matter to understand how logging operations are conducted in North America as soon as it is realised that they all have one important feature in common. It is literally true to say that extraction is by rail in all operations of any magnitude outside the North-Eastern States and North-Eastern Canada. Transport by rail has displaced water carriage even in the case of floatable species. A careful study of the main features of logging railways is of importance because they differ in many respects from permanent lines open to public traffic. It need not, for example, be taken for granted that expenditure on construction and maintenance would be the same in both cases.

North America has nothing to say in favour of the use of SMALL GAUGE LINES for logging purposes. The inference I draw is that the field in India for lines as small as 2 feet is very very small for logging purposes.

Two very important features of logging railways are the use of bogie wheels for cars of *all* descriptions, and the use of geared locomotives on steep grades.

The chapter on OCEAN RAFTING will, it is hoped, lead to developments in Burma. The supplementing of shipping by rafting may be expected not only to improve the market for teak, but also to lead to more extensive use of Burmese timbers for railway sleepers in India.

Volume II.—Sawmills (Chapter VII).

11. The chapter on SAWMILLS is the longest in the whole report. The more the writer saw of Western Sawmills the more he became convinced of their suitability for India. Indian mills are based on British practice and the latter is totally different to Western practice.

Volume III.—Wood Manufactures (Chapters VIII and IX).

12. The foregoing remarks apply chiefly to SAWMILLS for rough lumber, *i.e.*, for the breaking down of logs, but the case is different with subsequent manufacture. British planing and resawing machines are quite as good as those in America.

A visitor to Canada and the United States cannot but be struck by the intimate relation that exists between the development of lumbering and that of the industries which depend upon it for their supplies of material. The one cannot expand without the other. There is a every reason to suppose that the same thing applies in India. With a view to developing the logging of its forests I believe that it will pay the Government of India to take more active interest in what happens to wood after it has passed through the stage of conversion from the log in a lumber mill. Progress is hampered by lack of knowledge. Very few people outside the trade know anything about the manufacture of VENEERS, PLY WOOD, MATCHES, BARRELS, SHINGLES, etc. I have therefore gone to some trouble in writing short descriptive notes on some of these manufactures. The information given should be sufficient to enable anyone not previously conversant with the subject to learn how to set about installation. The notes will also have served a useful purpose if they quicken the interest of forest officers in general. They also aim at enabling officers of Government to form an opinion on such matters when questions come up for decision,—applications for concessions and so forth.

Volume III.—Research (Chapters XII and XIII).

13. The repeated references in the report to RESEARCH IN TIMBER will, it is hoped, help to a realisation of the urgent necessity for more extensive research than has been accomplished hitherto. I am firmly convinced that the development of manufacture on a commercial scale in India will be seriously handicapped if it is not preceded by much more extensive research than has been given to Indian timbers up to the present. The research will be expensive and it will certainly call for the services of special men.

Dry Kilns (Chapter XII).

One of the first things to be done is to build experimental kilns for the artificial seasoning of Indian timbers. The importance of this subject cannot be over-estimated. Without it, nothing much is ever likely to be done with many of the less durable species and with it, the value of several woods in the market is likely to be increased.

Glues and Cements.

A separate report on the subject of GLUES AND CEMENTS has been written. CASEIN is the chief constituent of one of the most popular plywood cements in both Europe and America. It came as an eye-opener to learn that something like 60 to 70 per cent. of the world's supply of Casein comes from India. If to this be added the fact that trade is hampered by the uncertain quality of the Casein as shipped from India, a good case would appear to be made out for suggesting that special enquiries be made on the subject. By doing so, not only may plywood manufacture in India be helped on but the export trade in Casein may be expected to benefit.

Water Hyacinth (Chapter XIV).

The description of operations for dealing with the WATER HYACINTH in Louisiana and Florida will, it is hoped, be of interest and value to officers in Burma. The subject is of more than departmental interest, and it is hoped that consideration of the information derived from my tour in America will not be limited to the clearing of waterways used for the floating of departmental teak logs in the Pegu Circle.

F. A. LEETE,

February 1919.

I. F. S.

CHAPTER I.

DESCRIPTION OF THE FORESTS; OPERATIONS VISITED.

It is not proposed to give a detailed description of the forests in Canada and the States. It will be sufficient to refer to the main grouping of the chief types.

From the provinces of Saskatchewan, Alberta and Manitoba in the north right down to the Gulf of Mexico in the south runs a broad treeless belt, separating the forests in the east from those in the west. In the east there is a great variety of hardwood types and also of soft woods. In the west only softwoods are to be found right away from British Columbia down to California and New Mexico.

In the latter (*i.e.*, west of the prairie belt) there are two well defined parts, corresponding to the two main ranges of the mountains. "The Rockies" is a comprehensive term, used in English school books to include all the mountains on the western side of the continent. In reality there are two more or less distinct series of ranges with a treeless and arid belt of country between them. Along the Pacific Coast is the range know as the Cascades, and in this range are all the big Douglas fir forests of British Columbia, Washington and Oregon and also the gigantic Redwoods of California. In the other series of ranges, generally spoken of as the Rocky Mountains proper, running north and south and anything up to a thousand miles east of the Cascades, the trees do not reach such large dimensions, Yellow Pine being the chief species.

Whilst in the Douglas Fir forests the writer was repeatedly asked how big the trees were in India and replied that they were small. On the other hand, in reply to the same question in Idaho the trees in India were said to be big. This remark serves to illustrate how great a difference there is in the sizes of the timbers in these two regions.

In the forests west of the great prairie belt there is greater variety. In Ontario and Quebec glimpses were obtained of vast areas under Spruce and other Conifers. Along the Atlantic Coast large forests of Loblolly Pine still exist and in the south, in Louisiana, the most valuable softwood in this part of America — Longleaf or Pitch Pine — and Swamp Cypress are to be found.

On this side of the continent there is also a series of ranges running north and south under several names — the Adirondacks in the north, the Alleghanies in the middle and the Appalachians in the south. These hills are clothed with a great variety of hardwoods. Twenty years ago only a limited number of them were marketable, to-day most of them find a ready sale.

2. In the North-Eastern States and in Eastern Canada all the logging is done in the summer months, and hauling to floating streams, or to rail, is done in the winter. Logs to be floated out are piled on the ice ready to move down when the rivers open. As such conditions are of little interest in India very little time was given to them by the writer. Whilst at Ottawa in February railing of pulpwood under snow was seen and also an operation in Eastern Quebec where haulage on snow is done by means of a gasoline caterpillar tractor.

Time was about equally divided between the South-Eastern States and the Pacific Coast. Full of interest as the Douglas Fir and Redwood forests are, they stand in the second place for study by officers from India, because of the immense size of the "stands" in them, which are so unlike anything in India.

Speaking generally, the forests in India may be described as being of mixed hardwood types with a small "stand" of from 5 to 10 tons per acre. Only in the coniferous forests in the higher Himalayas is there anything comparable to the heavy stands of 200 tons, or more, per acre, that are common in the Douglas Fir and Redwood regions. On the other hand in the Eastern States and also in Idaho and Montana (Inland Empire) many instances can be found of big lumber operations in parts of which areas are being worked not yielding more than 5 to 10 tons per acre.

Places visited.

It is no exaggeration to say that as many years would be required as there were months at the writer's disposal if it were desired to visit all the lumber operations in North America. In the extent of ground to be covered, and the variations of forest type to be met with, the problem would be similar to exploring all the forests in Europe. The United States of America cover an area three times as large as that of India, and with five times the area under forest.

Moreover, in addition to the huge area of the forests, and the long distances that have to be travelled to cover them, the matter of ownership increases the difficulty of getting to know something about them quickly. Practically all the forests in India belong to the State, and it would be a simple matter for the Forest Department to supply information at short notice of all the principal timber operations going on in them.

Only one-fifth of the forests in the United States of America belong to Government, and it is only in these forests that the Forest Service exercises full control over all operations and has complete records of what is going on. It is also to be remembered that the National Forests are not being worked at present to anything like the same extent as private ones. The policy is to hold them back as much as possible as a reserve for the future. For these reasons most of the visits were paid to privately owned forests.

The investigations of the Forest Service at Washington brings it into touch with a considerable number of firms in various parts of the country, but there is no branch of the Service dealing with lumbering in general. It was therefore necessary to look outside for fuller information as to the best places to visit. On the advice of the Forester, Washington, Professor Bryant was consulted. This was fortunate as he has had exceptional opportunities for studying operations in all the Eastern States. Even Professor Bryant has not had occassion to keep in close touch with all localities right up to date; and, in the light of subsequent experience, if the tour were to be done over again some alterations would be advisable in the choice of localities to be visited.

The following is a list of Lumber operations visited:—

Ontario and Quebec.

1. J. R. Booth Co., Madawaska, Ontario (also pulp mill).
2. Ouelle Pulp and Lumber Co., River Manie, Quebec.

Eastern States.

3. John. L. Roper Lumber Co., New Bern, North Carolina.
27. Blount Boom and Lumber Co., Davis, West Virginia.
4. Little River Lumber Co., Townsend, Tennessee.
5. Carrier Lumber Co., Sardis, Mississippi.
6. Lamb-Fish Lumber Co., Charleston, Mississippi, (also staves).

Southern States.

7. Great Southern Lumber Co., Bogalusa, Louisiana, (also pulp, veneers and creosoting).
8. Lutcher and Moore Cypress Co., Lutcher, Louisiana.
9. Dibert, Stark and Brown Cypress Co., Donner, Louisiana.
10. Calcasieu Longleaf Lumber Co., Lake Charles, Louisiana.
11. Kirby Lumber Co., Jaspar, Texas.
12. Arizona Lumber and Timber Co., Flagstaff, Arizona.

Western Pacific States.

13. Union Lumber Co., Fort Bragg, California.
14. Goodyear Redwood Lumber Co., Elk, California.
15. Lamoine Lumber and Trading Co., Lamoine, California.
16. Weed Lumber Co., Weed, California, (also veneers).
17. Wind River Lumber Co., Wind River, Oregon.
18. Bridal Veil Lumber Co., Bridal Veil, Oregon.
22. Eley Lumber Co., Arlington, Washington, (no mill).
23. St. Paul and Tacoma Lumber Co., Kapowsin, Washington.

British Columbia.

19. Timberland Lumber Co., New Westminster, B. C.
20. Bloedel, Stewart and Welch Lumber Co., Myrtle Point, B. C. (no mill).
21. Empire Lumber Co., Cowichan Lake, Vancouver Island, B. C. (no mill).

Inland Empire.

24. Blackwell Lumber Co., Fernwood, Idaho.
25. Rutledge Lumber Co., Keeler, Idaho.
26. Potlatch Lumber Co., Elk River, Idaho.

The serial numbers indicate the order of the visits. At all the operations in the list, except Nos. 12, 21, 22, 23, 26, mills were seen in operation—usually a planing mill as well as a lumber one. The notes in brackets indicate where other manufactures were seen at the same places.

Besides the above, special visits were paid to the following :—

Ontario	J. Davidson Company, Planing and Box mill, Ottawa.
Arkansas	Archer Lumber Company, Hardwood mill, Helena.
	Penrod, Jurdon and McGowan Company, Veneer mill, Helena.
Louisiana	Longville Lumber Company, Lumber mill, Longville.
Texas	Western Naval Stores Company, Turpentine, Jaspar.
Arizona	Saginaw and Manistee Company, mill, Williams.
Oregon	Ziegler and King Company, mill, Portland.
B. Columbia	Canadian Western Lumber Company, mill, Fraser Mills.
	Laminated Materials Company, Veneer mill, New Westminster.
	Vancouver Cooperage Works Company, Vancouver.
	Canadian Pipe Company, Vancouver.
	Vancouver Creosoting Company, Vancouver.
Michigan	J. P. Hasty Company, Cooperage Works, Detroit.
Ontario	Standard Chemical, Iron and Lumber Company, Longford.
New York	Blount Lumber Company, mill, Lacona.

CHAPTER II.

LOGGING RAILWAYS.

Professor Bryant's "Logging."

3. The chapters on logging railways in Professor Ralph C. Bryant's book on "Logging" are well worth careful study by anyone interested in the subject. They contain a very good description of the laying out, construction, equipment and working of such railways. Free use of the book has been made in this report in describing the writer's experiences on his tour.

4. The most logical way of describing lumbering operations would naturally be to start with the felling of the trees and to take up the various operations in chronological order. The reason for commencing with logging railways is that they are by far the most important item in lumber operations almost everywhere in Canada and the States.

At first the writer's ideas about American methods of handling timber were very vague. It did not, however, take long to realize that all the operations visited had one thing in common on which they depended absolutely for success, *viz.*, a logging railway of some kind or other for the extraction of the timber from the forests. These more or less temporary lines soon came to be taken as a matter of course.

Development of railways.

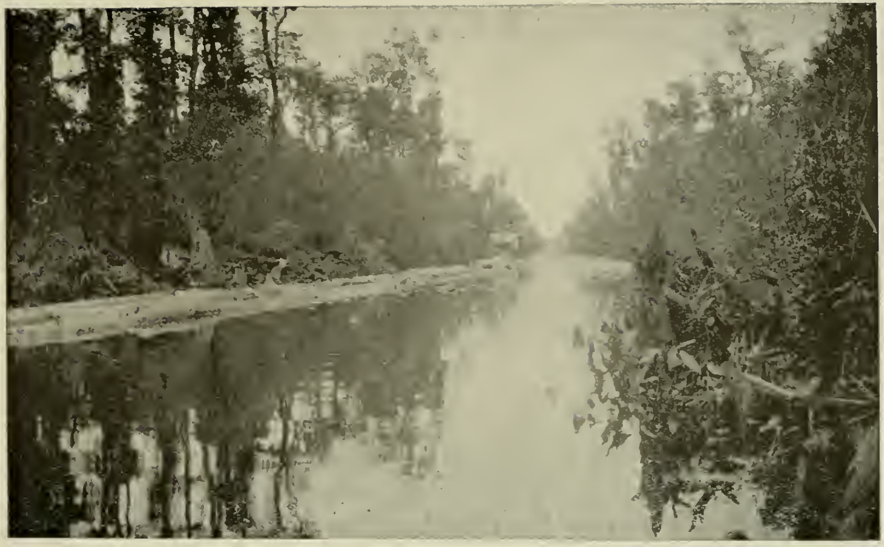
5. Outside a relatively small area in Eastern Canada and the North-Eastern States it is literally true to say that the basis of every lumber operation of any size is a logging railway. It is the back-bone of the whole organization; success depends absolutely upon it. Thirty years ago the position was very different. The use of railways for transporting logs from forest to mill was then in its infancy and much greater reliance had to be placed on a logging superintendent's skill in managing horse and bullock teams. Water transport was used for all species that would float.

In the interval a remarkable change has taken place. Transport by rail is not only used for heavy timbers, but it has almost entirely replaced water carriage in the case of floatable species. This remark applies to old firms almost as much as to more recently established ones. There are not many firms, however, that have existed much more than twenty years in their present locations, and later firms went straight for rail transport from the start. So long as timber was floated out operations were limited to localities within easy reach of good streams, and mills often had to close down for part of the year. With the development of the lumber industry men had to go further afield, and something better than animal traction had to be used, even to bring the logs to a suitable river. An operator who was prepared to face the expense of laying down a track for this part of the haulage soon came to realize that it would pay to run his line right through to the mill.

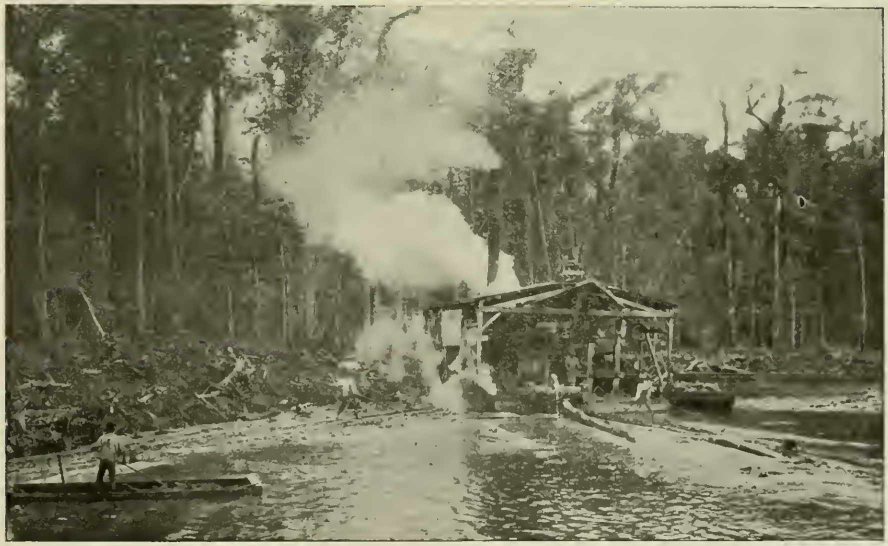
In 1910 there were approximately 2,000 separate logging railways with about 30,000 miles of track in operation in the States ("Logging," page 247).

6. The very first operation visited,—J. R. Booth Co., Madawaska, Ontario, is a striking example.

For nearly 40 years logs were driven down the Ottawa River to Ottawa, a distance of 153 miles. Finding himself hampered in the expansion of his business



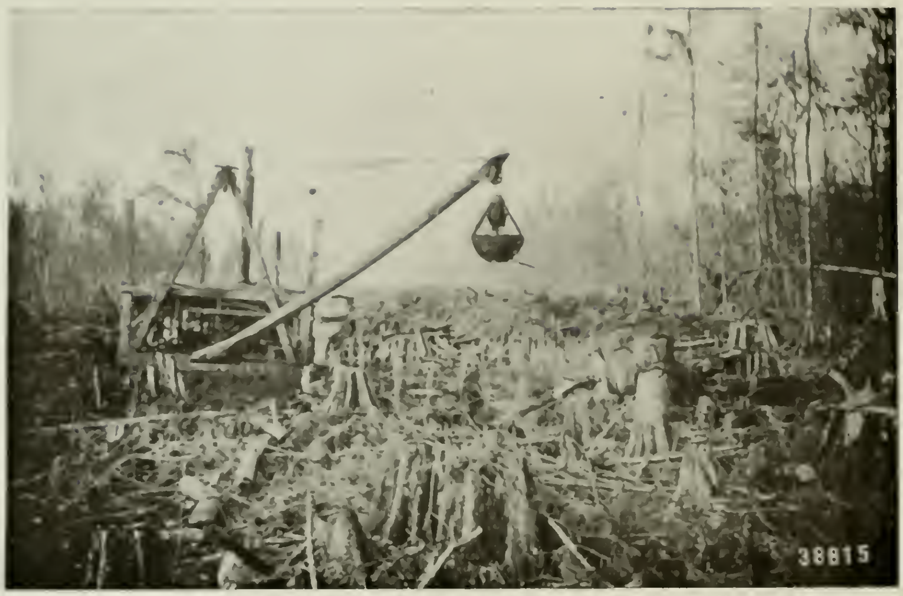
(1). Canal and Raft in Cypress Swamp, Raft being towed to mill by a Stern-wheeler.
Donner, Louisiana.



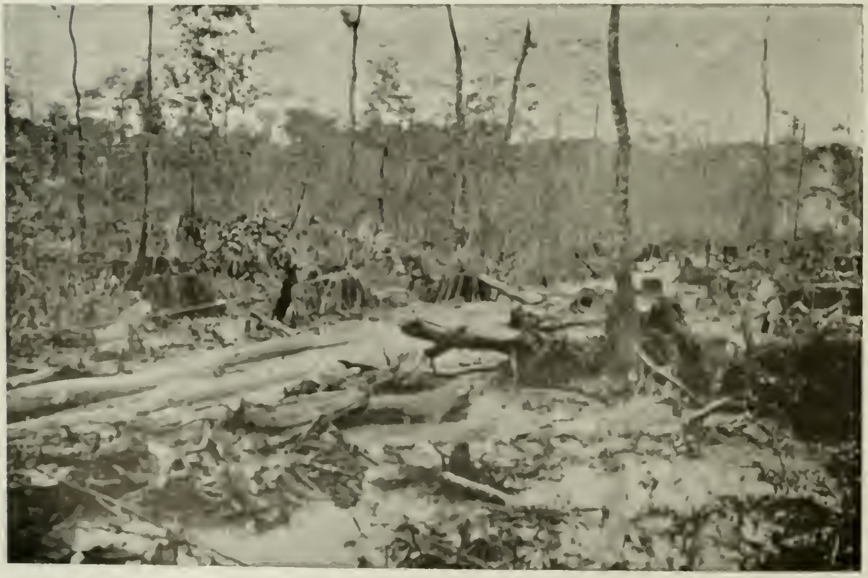
(2). Pull-boat at work in Cypress Swamp.—Donner, Louisiana.

(para 6).

Plate IV.



(1). Dredging Canal in Cypress Swamp, Terre Bonne, Louisiana. (U. S. Forest Service Photo.)



(2). Ground Skidding in Cypress Swamp, showing the nature of the country and the track along which the logs are hauled toward a canal,—Donner, Louisiana.

(para 6).

by the shortness of the floating season—4 months only—and realizing the loss due to sunken logs and breakages Mr. Booth started railway construction 19 years ago from the Ottawa end. Within a few years water transport was entirely given up. Later on the greater part of the line was taken over by the Grand Trunk Railroad Co., and now forms part of its system. The Lumber Co. only maintains some 19 miles of logging lines into the forests.

Cypress Swamps.

Even more striking examples of the substitution of rail for water transport are to be found in the Cypress Swamps of Louisiana. These forests are situated on low-lying ground only a few feet above sea-level and locally from 1 to 3 feet under water all the year round. The undergrowth is dense. Except that there is a greater mixture of species, Cypress and Gum being the most important, the forests bear a close resemblance to the *Kanazo* or *Sundri* forests in the Delta of the Irrawaddy and in the Sunderbuns. The old method of extracting the Cypress was by the use of canals " pull-boats " and ground skidders. By means of a dredger, mounted on a barge, canals were excavated about 30′ × 4′ and half a mile apart. Skidders mounted on barges (" Pull-boats ") hauled the logs into the canals up to a distance of 1,300 feet. At the various pull-boat stations the logs were roughly tied into rafts for towing to the mill by a stern wheeler. The writer went 3 miles up such a canal in a canoe and saw a pull-boat at work at Donner, La. Conditions were very unpleasant what with black and evil-smelling water, mud and mosquitoes everywhere.

It would probably be hard to find more uninviting conditions for the operation of railways, and yet they have come in and have displaced canals and pull-boats to a very large extent within the past 15 years. A clearing is made and, with the branch wood and worthless trees, a rough corduroy track is made on which sleepers and rails can be laid just above water level. Ballasting is done from the mill with anything handy, sawdust, slabs, waste pieces of wood, etc. The roadbed settles down remarkably well. To see such a railway a visit was paid to the operations of the Lutcher and Moore Cypress Co. The line runs for 24 miles from the mill at Lutcher out into the part of the swamp where felling is now in progress. Everybody lives at the mill ; nobody stays out at night in the swamp. First thing in the morning the train goes out with the men, who take their midday meal with them. Besides ballast for the line the train, also takes out fuel and water for the skidders and drinking water for the employees. The skidders only remain at one station for about a week or ten days, so that a good deal of work on shifting and extending the railway tracks is always going on.

Recommendations.

7. Examples of the use of logging railways could be multiplied indefinitely, but it is hoped that enough has been written to justify the conclusion that, *if India is to follow in the lines of development in America it must go in wholesale for logging railways.* Nothing much can be done without them, for the use of steam skidding machines can only be recommended in conjunction with them ; and even if steam skidding proves to be impracticable, animal haulage can only be relied upon for operations on a limited scale and in the more easily accessible forests.

Logging railways in the hills.

8. Great differences in the quality of the logging railways exist. On hilly ground, where steep grades are unavoidable, there is little or nothing to choose between logging tracks and public lines. The one is almost as good as the other. On open lines more attention is paid to giving a smooth finish to the ballasting, and the heavier traffic calls for heavier rails. But so far as concerns the evenness of the track, laying out of curves and superelevation of rails, there is little or nothing to choose between them. *The* important point is that heavy rails are used in one as much as in the other. Bridges and trestles are substantially built on the logging railways, but the quality of the timber is naturally inferior to that in such structures on more permanent lines. It is the same thing too with the workmanship put into them. This also follows from the fact that the running speed is less. Two details stand out. Gradients steeper than permissible on open lines are common, and trestles are more freely used to cross ravines and to reduce the amount of excavation and embankment.

9. A very good example of a well designed logging railway system in the hills is afforded by the operations of the Little River Lumber Co., Townsend, Tennessee.

The tract owned by the firm is 90,000 acres in extent and runs up one side of Smoky Mountain, a well known peak in the Appalachians. Between the top of the mountain and the mill at the bottom of the valley at Townsend is a difference in level of 5,600 feet. Up to date the railway has climbed about half way to the top. There are two distinct parts to the railway system. From Townsend to the main camp at Elkmont, 18 miles up the valley, the line has been built first class, with steel bridges and a ruling gradient of 3 per cent. This part is incorporated and worked as an open railroad, chiefly in order to give the management extra facilities for outside interchange of cars. This part cost Rs. 42,000 per mile to construct.

Above Elkmont the length of the line is steadily increasing. It is now about 16 miles. Gradients are anything up to 8 per cent. with an average of 5½ per cent.

A liberal use is made of trestle bridges. In the 10¾ miles above Middle Fork there are 52 trestles with a total length of 8,320 feet. The biggest is 350 feet long with 22 bays of 16 feet.

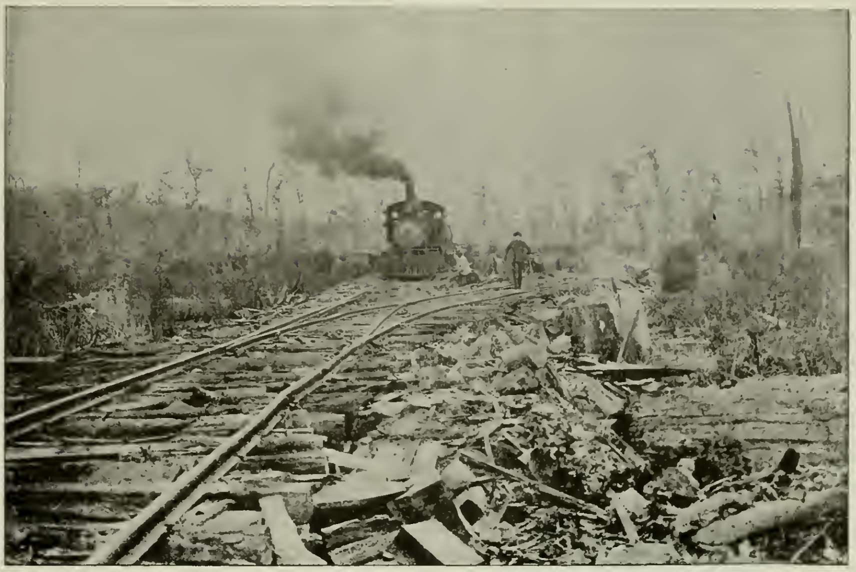
The track is of standard gauge (4′ 8½″), and the weight of the rails is 56 lbs.

"Shay" locomotives are used, with hand brakes on the cars.

Wrecks are rare; there were none in the past 12 months. In the same period there had only been one accident, due to a switch not being properly set.

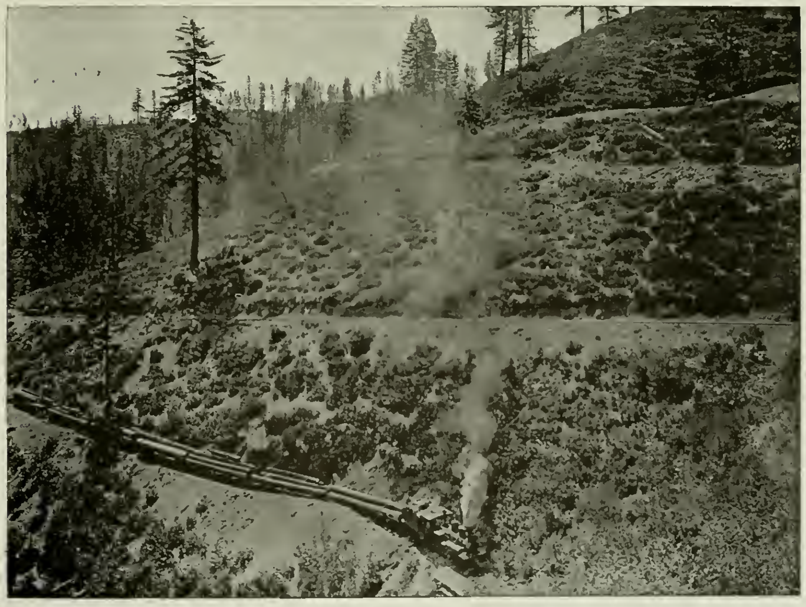
10. Several examples of a similar kind were seen in the course of the tour. One other may be mentioned.—The Goodyear Redwood Lumber Co., Elk, California—an example of a very good mountain railway on a 3 feet gauge. The quality of the line and the ruling gradients are much the same as at Townsend.

From Elk to the main camp is a distance of 24 miles by the railway. Fifteen miles out from Elk the line crosses a watershed 1,200 feet above sea-level. The mill itself, at Elk, is in a small bay about 100 feet above the sea. Rails are 40 to 50 lbs.



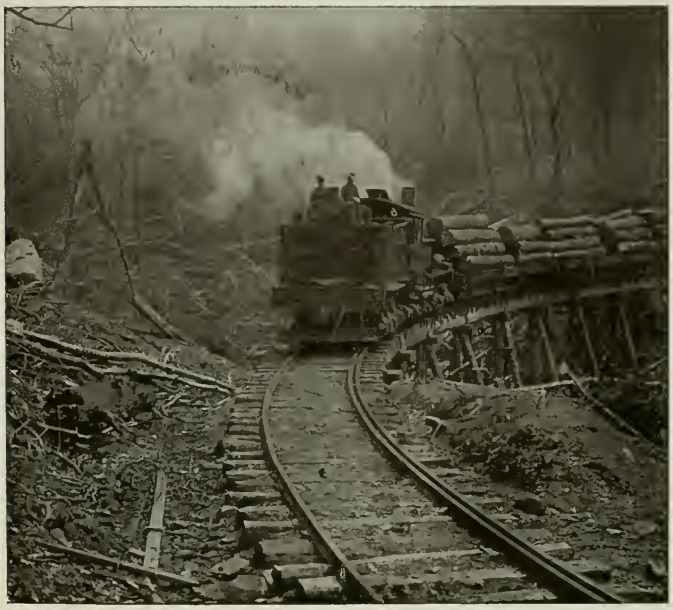
(1). Railway track in Cypress Swamp, showing ballasting with mill refuse.—Lutcher, Louisiana.

(para 6).



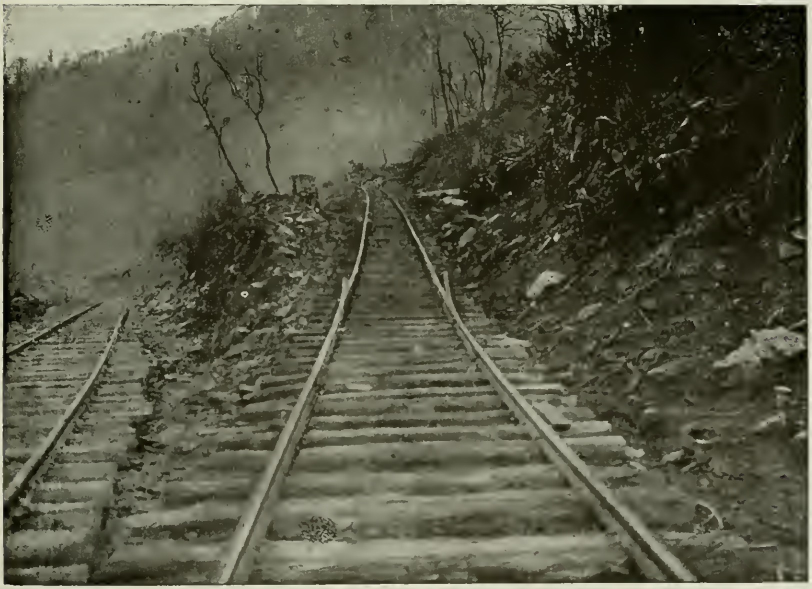
(2). Switch-backs and log train on 3-ft. track, Lamoine, California.

(para 8).



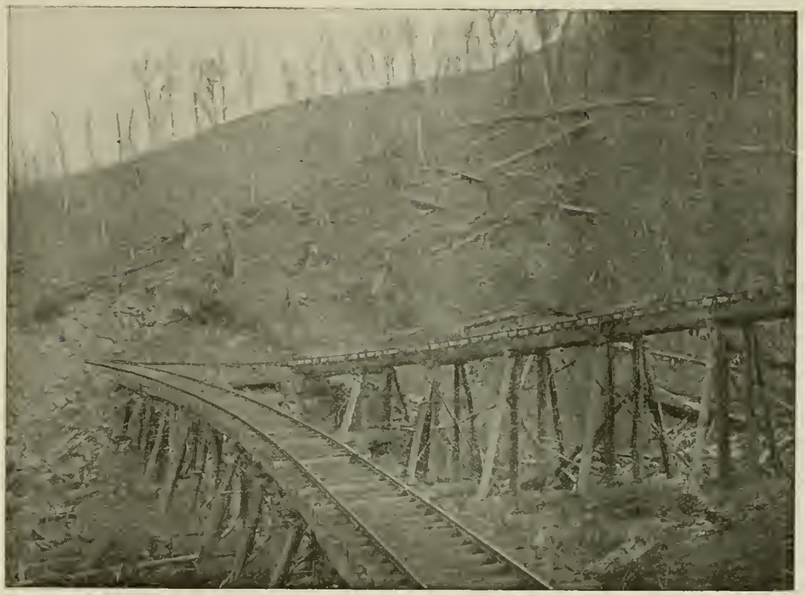
(1). Trestle and log train.—Townsend, Tennessee.

(para 8)



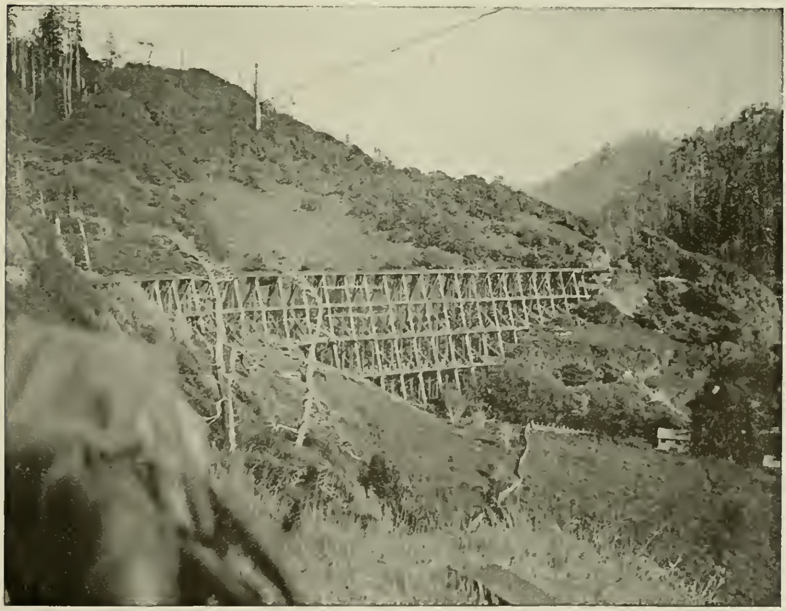
(2). Slip-Joints on log grades.—Townsend, Tennessee.

(para 9).



(1). Switch-back and trestles,—Townsend, Tennessee.

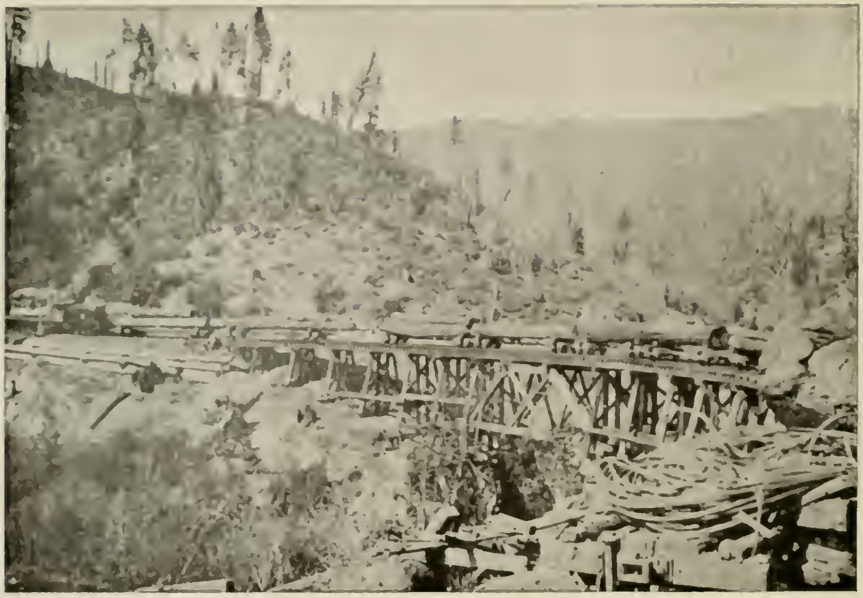
(para 9).



(2). Trestle 240 feet long and 150 feet high, 3 feet track.—Elk, California.

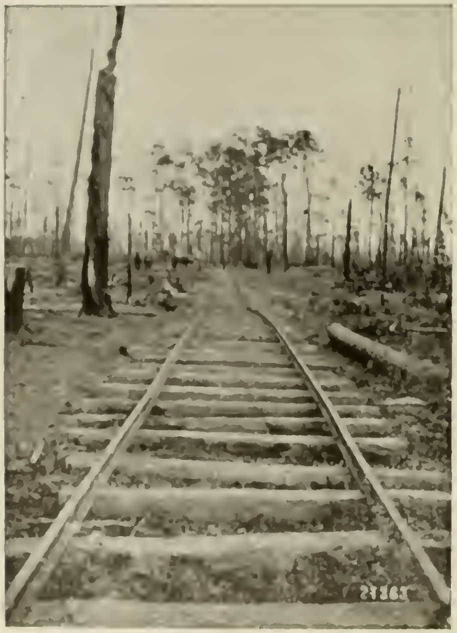
(para 10).

Plate VIII.



(1) Trestle and log train on 3-foot track, Elk,-California.

(para. 10).



(2) Logging railway in the plains,-Buna, Texas.
(U. S. Forest Service photo).

(para. 11).

Trestles are numerous and some of them are large. The biggest is 240 feet long and 150 feet high in the middle. Not far out from Elk the line is carried round the outside of the cliff about 200 feet up ; at high tide a stone can be dropped right into the sea.

Here again " Shay " locomotives are used, with hand brakes on the cars. The timber is large—the writer himself saw an eight ton log loaded.

Other examples could be given, but this one will, it is hoped, be deemed sufficient to illustrate the point that, in mountainous country, rails should be heavy enough to stand up under full loads; and alignment should be of good quality, even if gradients are considerably steeper and curves sharper than on permanent lines.

Logging railways in the plains.

11. When it comes to logging railways on the flat the story is a very different one. The best is of course still the best, but any old sort of track and any old second-hand collection of rails seems to be thought good enough. All that seems to be of importance in the first instance is fairly straight alignment and good curves. Given these desiderata, it does not seem to matter much if the line does get uneven, or if individual rails do become badly twisted.

The following extract from the writer's diary of his experience at New Bern, N. C., is a good example—

> " Here I had my first ride on a motor trolley and my heart was in my mouth for the first quarter of an hour. The line was so uneven and the rails twisted about so badly, first on one side and then on the other, that I thought we were bound to derail very soon. But it was all right and my confidence soon returned, even when we got up to twenty miles an hour. The bumping was pretty bad, owing to broken rails not meeting at the joints, and the general unevenness of the line. In two days I rode 120 miles by trolley without mishap."

As a matter of fact the track was worse than would have been the case under ordinary circumstances. Parts of it are fairly good, as they were laid with 50 lb. rails, but the firm had in stock a quantity of 30 lb. rails and used them on the line. rather than buy new stock. The track is of standard gauge.

At Sardis (Carrier Lumber Co.) and at Charleston (Lamb-Fish Lumber Co.), both in Mississippi, examples of standard gauge railways laid on more or less swampy ground were seen. Where the sleepers rest directly on the ground, or on branchwood, the settling under the weight of the train is even and the track remains good, but trouble occurs wherever the line rests on a stump. This does not give way like the rest of the ground in front and behind and so the rail gets bent. Inasmuch as the rails are constantly being taken up in one place and laid in another, as the operations progress, it naturally follows that the stock of rails deteriorates very much in quality. Really straight rail lengths are rare.

It is much the same story in the Cypress Swamps of Louisiana, to which reference has already been made. The conclusion arrived at is that there is no great need to spend much time or money on the alignment and upkeep of logging railways on the flat, *so long as there is not too great economy in respect to the weight of the* rails, always bearing in mind the maximum speed desired and the amount of traffic to be carried. For some time at any rate, in India, any logging railways that may be built will not be called upon to carry up to the limits of their capacity, and so trains need not be extra heavy or be run at full speed.

There is one qualification to the foregoing remarks which should be made. It is obvious that a loaded car on a narrow gauge track is more top heavy than on a broad gauge one. The narrower the track the greater therefore is the necessity for being more particular as to the dressing of the line. Logging railways in a gauge as small as 2 feet would be a very doubtful proposition indeed in the Cypress Swamps. Derailments would be much more common, without excessive expenditure on the maintenance of the track.

[illegible] vs. narrow gauge railways.

12. Light 2 feet gauge plant with 20 to 25 lb. rails has been advertised a great deal in India. It will be as well, therefore, to discuss the matter of the choice of gauge in some detail.

The following points are made :—

(i) It is false economy to use too light rails. To give a sufficient margin of safety for the use of powerful locomotives and full loads, even, on a 2 feet track, 35 lbs. is a minimum and 40 lbs. would be preferable. It would not cost much more to have 45 lbs. rails, and in that case one might as well go in for standard gauge equipment.

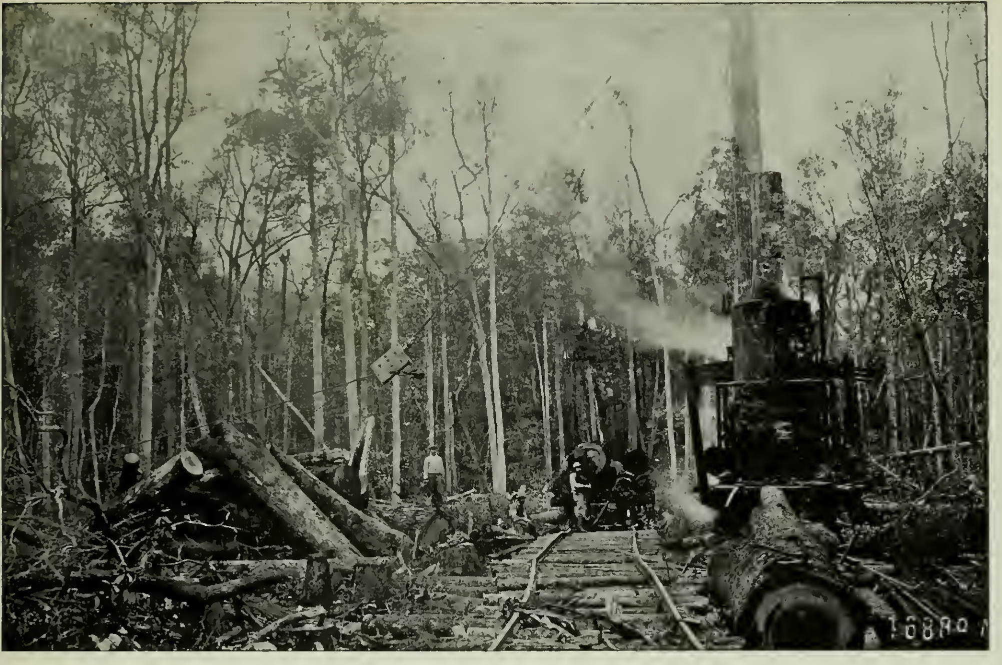
(ii) To haul the same amount of timber in a given time on a 2 feet line as on a metre gauge one would require double the number of engines and cars and a larger staff.

(iii) Judging by experience in Burma, there is not much to choose between 2 feet and metre gauge tracks in respect to sleepers for timber traffic in forests with a heavy rainfall. Rough hewn sleepers, or rejections from supplies to public railways, are good enough. Short length iron ties do not as a rule stand up well.

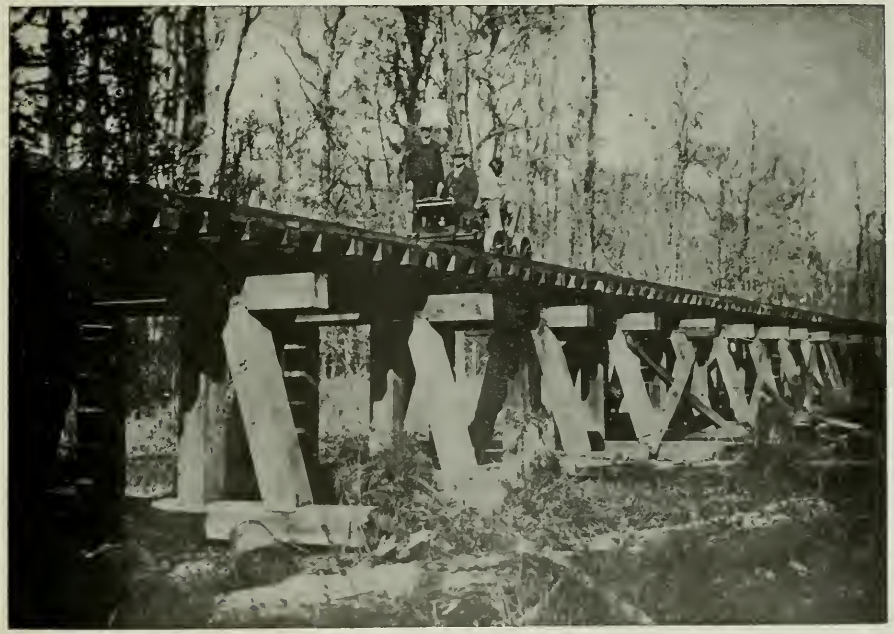
(iv) There is no comparison between the loading of heavy logs on 2 feet gauge cars and on larger ones. Owing to the necessity for being so much more particular as to balance, logs cannot be taken as they come and must not be dumped down heavily on the small cars. Even with well equipped cranes loading is decidedly slower. The subject of loading on rail is described in detail in Chapter IV.

(v) It is the same with steam skidders as it is with loading machines ; they are far too top-heavy to be moved quickly on anything so small as a 2 feet track. To think of shifting a steam " donkey " once a week on such a line would be quite out of the question.

(vi) Transhipment is as expensive as loading. It is a common practice in America to send logs long distances over public railways to central mills. The same remark applies to stores required in lumber camps and mills.



(1). Skidder at work in Cypress Swamp, showing rough character of the spur line,-Ware, Georgia.
(U. S. Forest Service Photo).



(2). Trestle across swamp,-New Bern, North Carolina.

(para 11).

Recommendations.

13. The writer travelled on 20 standard gauge logging railways, but he only came across 3 narrow gauge ones, and they were all of 3 feet width. Without going so far as to say that nothing smaller than 3 feet exists, it may safely be stated that, if American practice is to be any guide for India, *it should be laid down as a general rule in the latter country that nothing smaller than 3 feet should be used.* No proposal for an infringement of this rule should be allowed unless :—

(*a*) No connection is contemplated, or likely, with an open line.

(*b*) The timbers to be handled are of small size, of fairly uniform dimensions and capable of being loaded by hand.

These remarks do not conflict with the notes on choice of gauge on page 249 of "Logging," because by narrow gauge lines Mr. Bryant refers to nothing less than 3 feet.

So far only the absolute minimum has been considered. Another point may now be made. In America well over 90 per cent. of the logging railways are of standard gauge (4′-$8\frac{1}{2}$″). In India it should therefore be the same, *i.e., logging railways should be on the same gauge as the public railways in their vicinity.* This would mean metre gauge (3′-3″) in most cases in India.

Outline of railway system.

14. In a typical logging railway system there are one or more main lines and a series of branch lines, called "Spurs," ramifying all over the area being worked. Having decided on the method by which logs are to be dragged to the railway and the economic limit of distance for haulage to the latter (or "yarding" as it is called), the skill of the Forest Engineer comes in, in working to this limit with the minimum amount of line. Spurs should therefore be as nearly parallel to each other as possible, and run fairly at right angles to the main line.

The usual haulage limits for skidding machines are about 800 feet 1,500 feet or 3,000 feet according to the method employed. The choice of method is largely a matter of topography, undergrowth, soil and "stand" per acre. As a rule choice is possible, *i.e.*, logs can generally be hauled in more than one way, so that the problem to be solved is the striking of the correct balance between expenditure on skidding and railing respectively. On flat ground it is the general experience in

---

NOTE.—The above mentioned opinion was formed in Canada and in the States. Enquiries about Canadian and American lumbering operations in England and in France during the war gave no ground whatever for desiring to change this opinion. It is true that 2′ and 2′ 6″ lines were freely used both by the Canadians and by the Americans, but circumstances were so exceptional that it would be very misleading to apply the results to ordinary operations. The amount of labour was greater, and its quality was far higher than would ordinarily be met with in lumber camps. To a man, everybody was so keen on doing his utmost for the War, that difficulties vanished and the amount of work accomplished was prodigious.

In Burma there is very little sawing at stump and logs are as a rule large, so that the field for the use of small gauge lines is a very small one. In the United Provinces on the other hand, the greater part of the conversion is done at stump. The supply of hand sawyers is large and the quality of their sawing is good so that one would naturally hesitate to make any change. So long as this method of conversion continues there may be a greater field for the use of small gauge lines; always however bearing in mind the necessity for linking up with open lines. The forests in the United Provinces are served partly by metre gauge railways and partly by broad gauge lines. The perennial trouble which appears to exist at Bareilly, Moradabad and elsewhere with transhipment. affords deplorable examples of the drawbacks to having more than one gauge. One should think twice before running the risk of duplicating the evil by introducing a still smaller gauge.

America that it pays to have a close network of spurs about a quarter of a mile apart with short hauls of 800 feet for the skidders. Remarkable as it may seem at first sight this observation holds good even in swampy ground, for example in the Cypress Swamps of Louisiana. On steep hills, and especially where blasting is necessary, the cost of railway construction mounts up rapidly and it usually pays to get the longest possible haulage out of the skidders. With machines and rigging capable of yarding up to 3,000 feet the railway tracks average about a mile apart. Even so, it may not be practicable to bring every tree within reach of the skidders. The steepest slopes and poorest stand are often to be found at the tops of hills, and in such places the use of skidders in tandem, or of haulage by animals, may be indicated.

An experienced logging engineer in America would be able to make up his mind after a very short inspection as to the method most likely to give the best results. The ground work of the whole operation would be a railway system in any case. He would examine the whole tract from that point of view. He would get a mental picture of his main lines and of obligatory points; always as he progressed making mental calculations as to the amount of timber each section would yield.

There is a significant remark on page 253 of "Logging":—

> "Good railroad engineers without logging experience are usually a failure at logging railroad work, because they are not able to subordinate some of their ideals regarding standard railroad construction to the demands of practical logging."

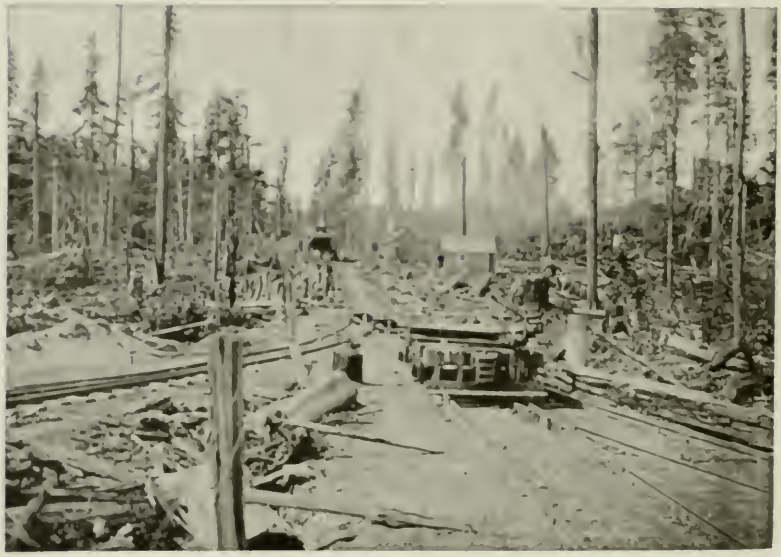
Cost of logging railways.

15. Main lines cost from Rs. 11,000 to Rs. 29,000 per mile, and spur lines from Rs. 10,000 to Rs. 16,000 inclusive of Rs. 9,000 to Rs. 11,000 on rails and other supplies. The cheapest lines are on the flat and dry ground in the Atlantic Coast region. The most expensive ones are in the steep mountain regions in the Pacific States.

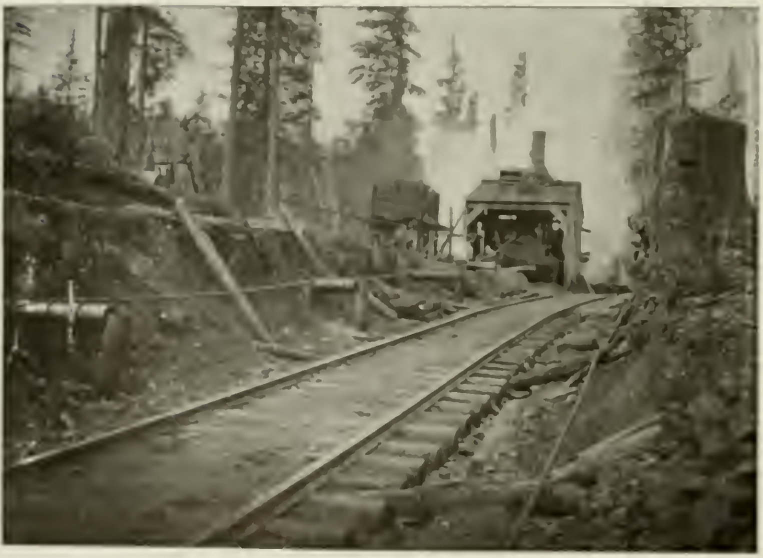
An average of one man per mile on spurs is enough for maintenance.

It would be of very little use to give more detailed figures of the cost of construction and upkeep of logging railways in America as a guide to probable cost in India. Materials would cost more, labour less. Moreover, estimates prepared by an engineer in India in, say, 1914 would be of little use in 1919. All that need be remarked is that experience in America shows that a liberal discount can generally be made from the estimates of engineers who have only been accustomed to deal with permanent railways. The reason is not far to seek. On a permanent line everything possible is subordinated to permanency. Heavy expenditure may be incurred for the sake of a low ruling gradient, bridges are of solid construction and the permanent-way is heavily ballasted and dressed to ensure smooth running.

It is very often just the opposite with a logging railway. It is only wanted in any one place for a short time, and so construction can well afford to be of a decidedly temporary character; steeper grades reduce length, wood takes the place of steel in bridges, etc.



(1). Cable Railway or Incline ; special car for cable.—Arlington, Washington.



(2). Hoisting engine at top of Incline.—Arlington, Washington.

(para 17).

16. There is need for caution, however, in applying these American ideas in India, especially in respect to timber bridges and trestles. The supply of timber is so large in America, and operations are conducted on such a big scale, that it does not seem extravagant to use large quantities of good timber on the construction of railways, mills, camps, etc. Moreover, common timbers are durable enough to last for 5 to 10 years without special treatment. Trestles built in this way often stand from 10 to 15 years without renewal.

In India, none but the best of the timbers would last long enough for main lines, and preservative treatment would probably be advisable for cheaper woods even when used on temporary bridges. The same remark applies to sleepers, although India may well learn one thing from America in respect to them. Not only are the great majority of the sleepers hewn, but the standard of squareness and quality is decidedly lower than in India : that is, on permanent and public railways. Indian railway engineers appear to set too high a standard for sawn sleepers, and a good deal of branch wood and hollow timber, otherwise wasted, might well be turned into perfectly sound sleepers with the axe. On logging railways, too, the quality of the sleepers used in America is even lower than on open lines, at any rate on temporary spurs. In some places, it is the practice to lift sleepers on spurs and use them over and over again. In other places they are left behind and new ones are cut each time. It comes to this: no hard and fast rule can be laid down; the problem as to how to tackle the question of the supply of timber for construction is specially studied on its own merits in each locality.

Cable railways.

17. The maximum grade with geared locomotives is about 8 per cent. To save the expense of long tracks of the ordinary type, in several instances lumbermen have solved the problem of bringing logs down from a high elevation by the use of cable cars and steeply inclined tracks (*vide* "Logging"). The writer saw two examples. At Townsend, Tenn. an incline 2,500 feet long has been built to bring timber down from the head of a valley. Hauling of logs to the incline is being done by men and animals, as it was not thought to be worth while to use a skidder on them.

A little dressing and filling have been done to get the two rails level, but no attempt has been made to get an uniform gradient. It is anything up to 30 per cent., and there are several ups and downs.

At the head of the incline a 2-drum Surry Parke Loader does both the loading of the cars and the lowering of them down the incline. It also skids the logs up to a distance of 150 feet.

Although the plan is a rough and ready one, and it is open to argument that it might have been improved upon, yet it serves its purpose in costing less than extending the ordinary track so high up the valley for a relatively small number of logs. The inclines at Arlington, Wash (Ebey Lumber Co.) are of a different stamp. They are of a much more expensive type, as they were built for a much larger quantity of heavier timber.

A very powerful single drum donkey engine at the top of the incline operates the cable.

From the drum the cable passes down one side of the track to a train of wheels lying flat on a special car (to which the log cars are coupled) and then up the other side of the track to an anchorage at the top of the slope.

The operation is an interesting one and the inventor is proud of it as being a great success.

Although no example of double inclines was seen, yet it is believed that instances of them are to be found in the States. For heavy logs, a heavy type of track and equipment is called for, but for small logs, and for sawn timber (such as sleepers), light 2 feet tracks and small cars would suffice. They would lend themselves very well to double working, *i.e.*, one car going up whilst the other descended. This type might prove to be very useful in the Himalayas.

Steam Shovel.

18. In operations of any size a permanent gang is employed in taking up old spurs and in building new ones. The amount of new construction varies a good deal, depending as it does on the topography of the locality, the system of skidding, the stand per acre and the scale of the operations. It may be anything from 2 to 20 miles per annum.

Where there is enough work, and the ground is suitable, it pays to use a steam excavator. The favourite in America is the one made by The Marion Steam Shovel Company, Marion, Ohio.

The writer saw several of the shovels at work and can recommend them for use in India.

At Townsend, two shovels were purchased, but one has been found to be sufficient to do all the work required by the operations of the firm, amounting to about 5 miles of new track annually. The machine has a crew of 7 men and burns 2 tons of coal a day. It can pick up logs and fair sized boulders, and can excavate in any kind of ground short of solid rock requiring blasting. It can build up embankments as easily as it can dig out cuttings.

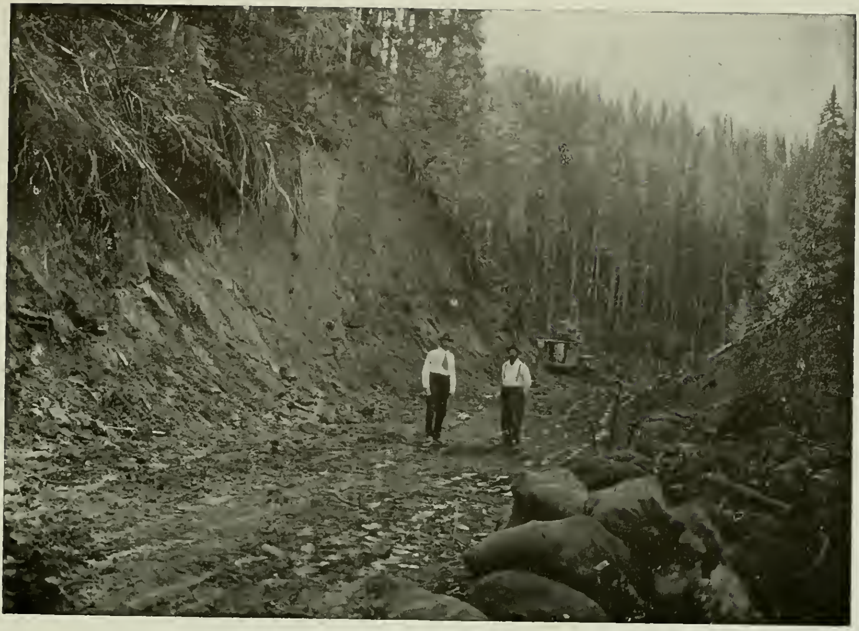
In ordinary soil the shovel's daily average is 50 yards of cutting or embankment 12 feet wide. The shovel travels forward on its own rails. There are three sections of them. As soon as the machine has moved off the end section of the latter is picked up, swung round and dropped in front. Mounted on a car the shovel can come in useful for loading ballast.

The Marion Shovel seen on the Potlatch Lumber Company's operation at Elk River, Idaho, in easy country clears 80 yards a day and is said to do the work of 50 men.

Track layers.

19. The following notes may be looked upon as supplementary to the remarks made on page 290 of "Logging" about mechanical devices for facilitating track laying and removal.

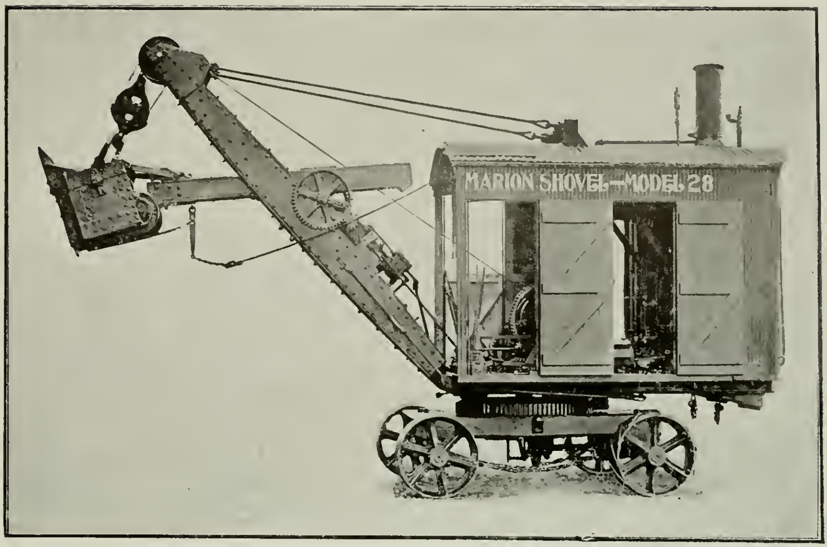
In several places two or three cars are kept specially for the purpose of handling rails and sleepers. The sleepers are piled on top and the rails are placed on iron brackets low down at the sides.



(1). Excavation of railway track by Marion Steam Shovel.—Elk River, Idaho.

(2), Track being cleared by Shovel.—Elk River, Idaho.

(para 18).



(1). Shovel mounted on Road Wheels.

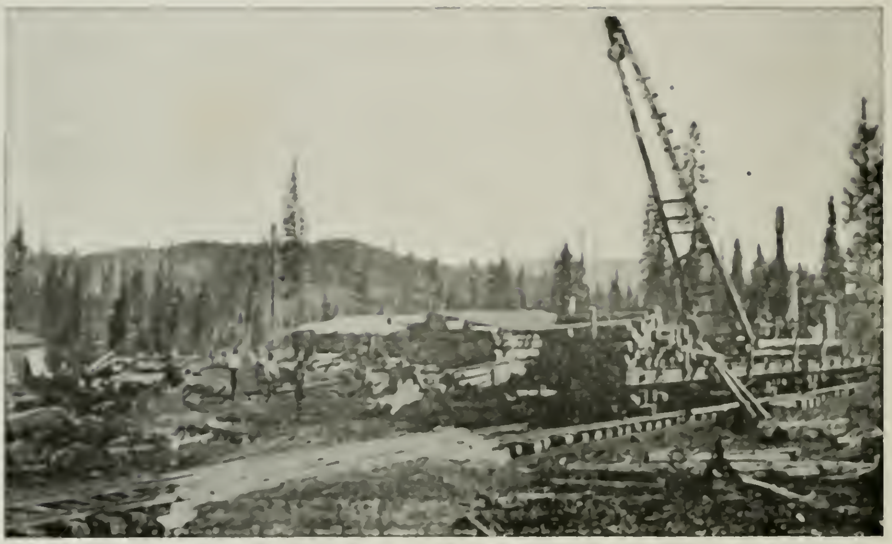
(2). Shovel mounted on caterpillar wheels.

(3). Shovel mounted on railway track.

Marion Revolving Steam Shovel
Manufactured by the Marion Steam Shovel Co., Marion, Ohio, U. S. A

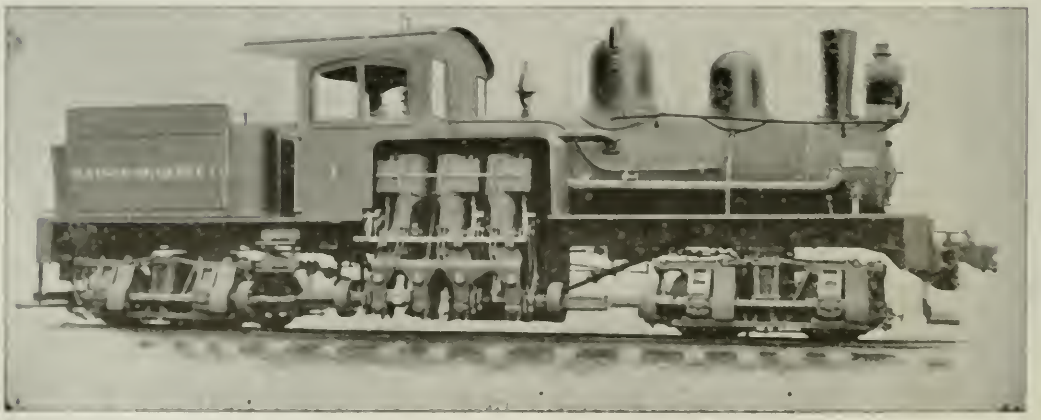
(para 18).

Plate XIII.



(1). Boom Skidder mounted on a railway car loading sleepers ;—Tyson Creek, Idaho.

(para 19)



(2). 70 ton Shay geared Locomotive. (Built by the Lima Loco. and Machine Co.)
The engine is not symmetrical ; to counterbalance the weight of the cylinders, pistons and crank shaft on the right hand side, the boiler is mounted off the centre towards the left.

(para. 20).

At Myrtle Point B. C. a useful overhead cable rig was seen at work. It consisted of a two drum " donkey " engine on a car with a derrick jib overhanging another car in front. A cable from one drum passed over the derrick, out to a stump or tree about 1,200 feet straight ahead along the track. On this cable ran a carriage with a pulley block attached, through which the lifting rope passed to the other drum. The front car had low brackets at the sides for rails.

After lifting a load of sleepers or rails, by slackening the overhead cable the carrier tended to run down forwards, dropping the load ahead clear of the car. The same rig can be used for lifting sections of rails with sleepers attached, thereby saving labour on spiking. This method has the drawback of necessitating even jointing of rails, and so discounts the use of odd lengths of rails.

A more elaborate contrivance is made by the Bell Railway Construction Car Company, Georgiana, Ala, consisting of an endless chain conveyer and engine to drive it to be mounted on ordinary cars.

Engines.

20. Locomotives of two kinds are used, *viz.*, *Rod* engines on low grades and *Geared* engines on grades of more than 3 per cent. All the Rod engines seen by the writer were built by the Baldwin Locomotive Works Company, Philadelphia, Pa. The usual weights are 50 and 75 tons.

The best known makes of geared engines are manufactured by :—

(1) The Baldwin Locomotive Works Company, Philadelphia, Pa.
(2) The Lima Locomotive and Machine Company, Lima, Ohio.
(3) The Climax Manufacturing Company, Corry, Pa.
(4) The Heisler Locomotive Works, Erie, Pa.

The " Shay " Engine made by the Lima Company is believed to be the kind most generally used in logging operations. The writer found it well spoken of everywhere. Having the cylinders at the side gives it a lop-sided appearance, but it is well balanced and stands up well under the rough usage of a logging operation.

All kinds of fuel are used, wood, coal, or crude oil. The United States Forest Service insists on the use of oil fuel in logging operations in National Forests, to reduce the risk of fire. The same remark applies to Spark Arresters. Thanks very largely to the influence of the Forest Service the majority of lumbermen are now-a-days keenly alive to the destructive effects of fire and take measures accordingly.

Cars.

21. The writer cannot call to mind seeing a single car in Canada or the United States either in log camps or on public railways mounted on single pairs of wheels in rigid frames. " Bogies " are used everywhere. Not only do they permit of the use of sharper curves, but they also keep to the rails better on uneven tracks. Without them more attention would have to be paid to fitting rails together and to ballasting. It is believed that wrecks are rare compared to the amount of traffic.

A single bogie (4 wheels) is usually termed a " truck ", two trucks coupled together form a " car ". A " flat " car is one having a full length fixed platform mounted on the trucks. In a " Skeleton " car there is simply an open framework. The longitudinal beams of the framework are called " Sills ".

Instead of a rigid platform or framework the trucks may simply be connected by a flexible coupling. By the use of coupling bars or rods of varying lengths, cars can be made to accommodate logs of varying lengths.

Steel frame cars are not much used. They are more expensive, and, in addition there is the same objection to them as to an all-steel log carriage in a saw-mill, viz., want of elasticity. Once sprung, frames are not easy to repair.

For small timber, such as pulpwood, etc., long wood stakes fitting into brackets at the sides of the car frame are used. For medium and large sized logs, patent iron blocks are general. They do not stand high, and the best patterns can be released from the opposite side of the car.

Some railways insist on logs being chained, others do not appear to be so particular and the load is not bound at all. Where chains are used, it is a common practice to put them on before loading the last log or two—the weight of the latter tightens up the chains.

Couplings are either a plain link and pin, or of the automatic knuckle type. The latter kind is universally used for public traffic on open lines. A drawback said to be attached to the use of this kind of coupling on logging railways is that, on very uneven tracks, cars are liable to jump sufficiently for one knuckle to drop free from the other one. Some lumber firms operating in hills use air brakes; others are content with hand brakes, even on grades as steep as 5 or 6 per cent.

A great variety of cars and fittings was seen by the writer, much of it very much the worse for wear as cars receive very rough treatment. Most of the lumber firms build their own cars, simply buying parts of the trucks, such as wheels and journals, etc. which cannot be made locally. The personal element seems to come in a good deal. As already remarked the bogie truck is common to all. *It is very desirable that this type be used on all logging cars built in India.* It is also advisable to go to the extra expense of air brakes where steep grades are unavoidable.

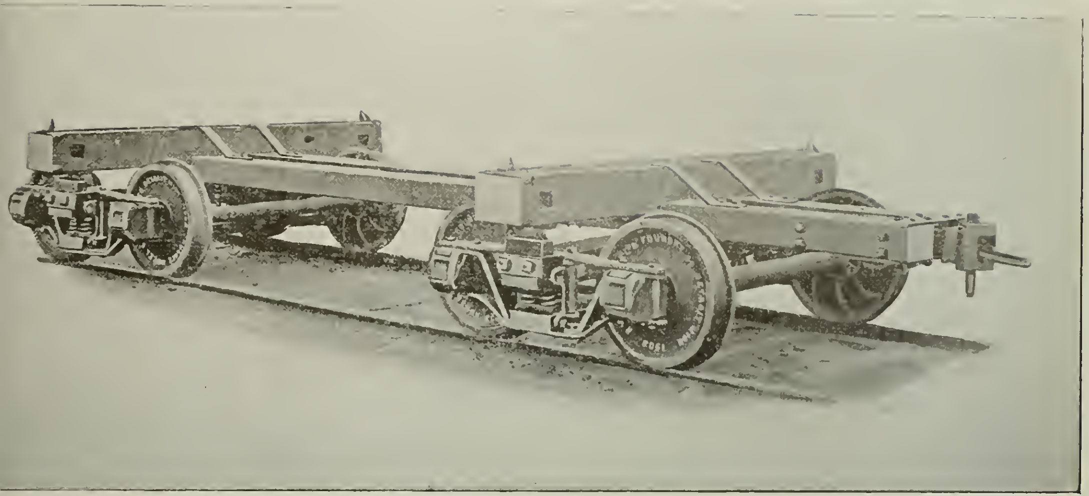
Speeders.

22. The writer travelled for several hundred miles on "speeders", or motor driven trolleys, and can testify to their great value in enabling the Manager, Superintendent, or Foreman to get about quickly and keep in close touch with work in all parts of an operation. Various patterns were seen in the course of the tour; from the plain, locally built springless trolley with a single cylinder motor coupled direct to one axle, to a modern automobile with flanged instead of rubber tyred wheels.

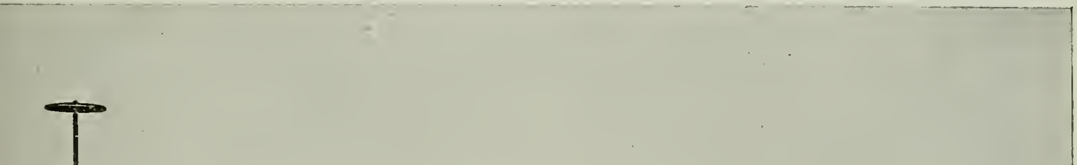
No logging railway in India should be without some form of motor trolleys.

Telephones.

23. No logging railway in America would be considered to be complete without a telephone system of some kind or other. The cost of installation is usually small, as nothing elaborate in the way of posts is necessary. At Bridal Veil, Ore, the writer saw a good example of the saving of time effected by the telephone. One of a train of cars loaded with logs became derailed whilst the train was being shunted from a spur. Ten minutes walk to the nearest call station enabled the Manager to send for another engine and men quickly.



(1). Skeleton pattern logging car.

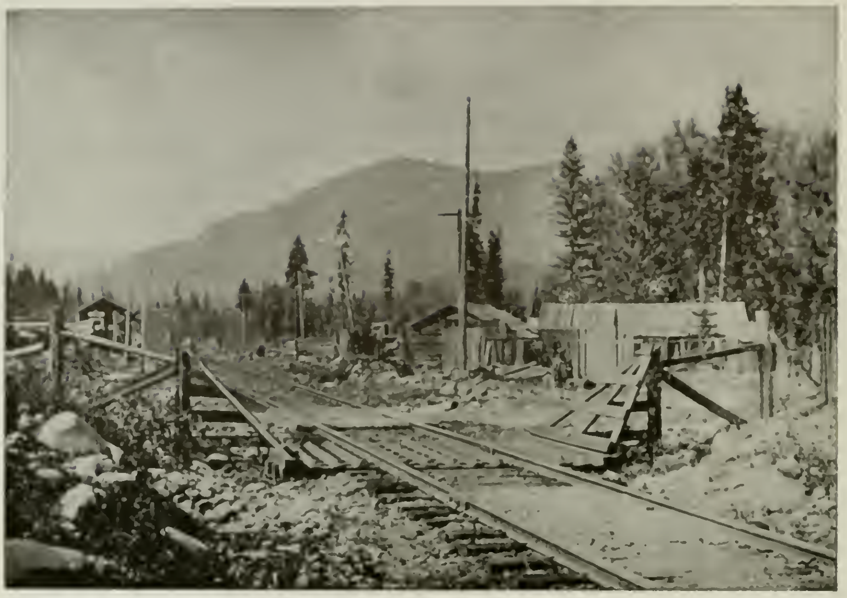


(2). Special short flat-car for handling lumber.

Manufactured by the Russel Wheel & Foundry Co. Detroit, Michigan.

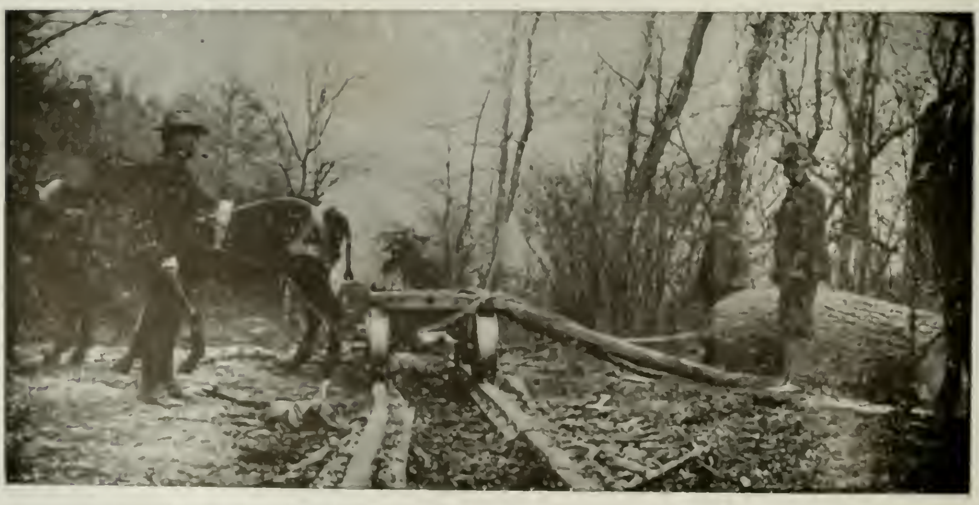
(para 21).

Plate XV.



PREVENTION OF CATTLE TRESPASS.

(1). Gates are not used where railways cross fences into or between fields. The simple plan shown in the photograph is to be met with everywhere and is very effective. Triangular pieces of wood are nailed on top of the sleepers, and a pit about 3 feet deep is excavated beneath them.



(2). Wood Rail Tramway; log being loaded by parbuckling, vide para 63.—Overton, Tennessee.
(U. S. Forest Service Photo)

(para. 24).

Wood rails.

24. Before the steel rail came into its own rails made of wood were used. They are still to be met with here and there. A description is given in "Logging". Even in America they are now out-of-date. Still less are they likely to find favour in India where timber decays so much more rapidly.

Tramways.

25. So far as the writer is aware no use of tramways is made in logging operations in America outside sidings, yards and mills. They are far too slow and therefore expensive. The same argument can be applied in India. If distances are so great that the use of rails is indicated for a particular forest to stand any chance of being exploited at all, the next step should certainly be to find out whether the logging operations could not be so far concentrated as to permit of the economical use of steam power.

CHAPTER III.

SKIDDING OF LOGS BY STEAM POWER.

What is skidding ?

26. In the transport of logs from stump to mill there are generally three distinct stages—*firstly*, the gathering of the logs together at convenient places near road or rail; *secondly*, the loading of the logs on carts or cars; and *thirdly*, the carting or railing to the mill. It is the *first* operation that is known throughout North America as "*Skidding*" or "*Yarding*".

Skidding and Loading are either done together as a single operation—a very rare occurrence—or they are performed concurrently as two separate operations, or they are carried out at separate times altogether. By the term "*Combined Skidding and Loading*" as used in this report, the second of these three methods is meant. This definition is in conformity with custom, because, in the great majority of cases, although the operations may be going on simultaneously, yet separate appliances and crews are employed for them.

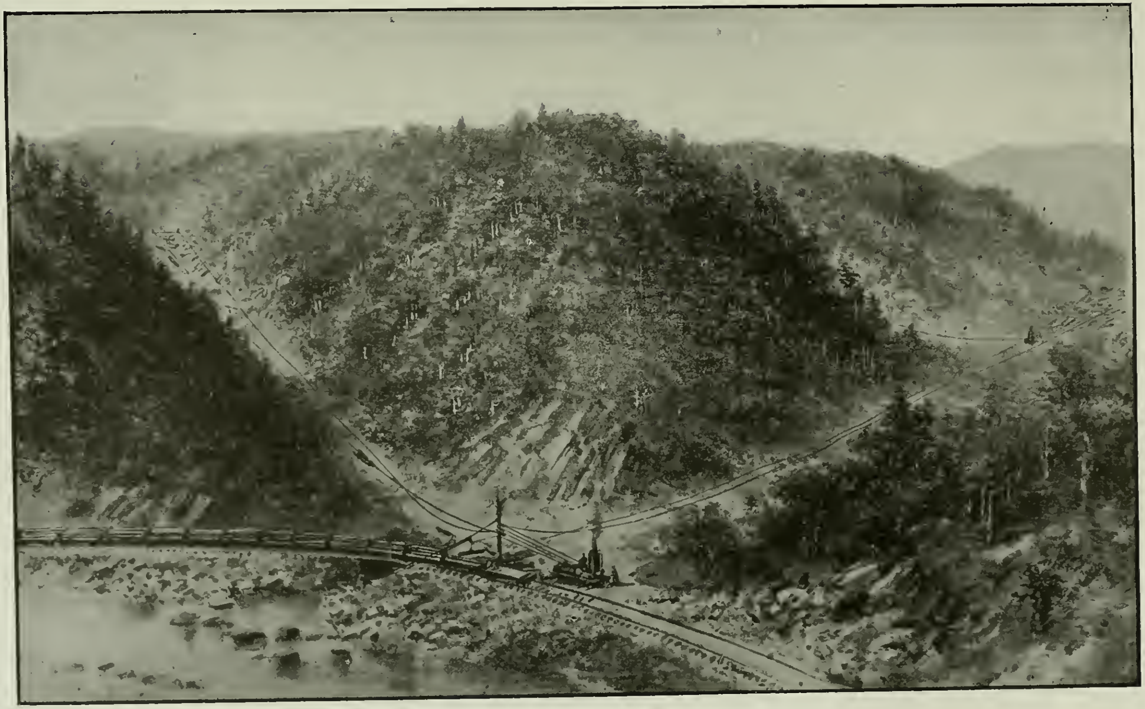
In order to focus attention later on to the importance of loading a separate chapter is devoted to it, and as few references as possible are made to the subject in the present one.

After a few introductory remarks on past history and on other methods of hauling logs without the use of skidders, the subject is treated under the following headings, the more important ones being marked with an asterisk.

Skidding.

*Designs of skidders.
*Methods of skidding.
*Effective hauling limits; relay skidding.
*Mounting and setting of skidders.
*Outhauling of skidding rope.
*Development of skidding systems.
Relation between time of felling and skidding.
Preference for uphill skidding.
Damage to forest growth.
Life and weight of machines.
Life and weight of ropes.
*Output.
*Time required to move skidders.
Labour saving devices: —
    Pilot and Spotting lines.
    Skidding cones.
    Slack pulling.
    Interlocking drums.
    Other devices.

Plate XVI.



Diagramatic view of Ground Skidding and Loading on Rail.
(Presented by Messrs the Lidgerwood Manufacturing Co.)

(para 26)

(1). Long Distance hauling with "Road" Engine in B. C.;
(Dominion Forest Service Photo).

(para 27).

(2). Diagrammatic view of "Ground" Skidding using Baptist cones, vide para 45.
(By permission of Messrs. The Lidgerwood Manufacturing Co.)

(para 29).

MacFarlane (Sky Line) overhead system.
North Bend overhead system.
Other skidding systems.
Electric and gasoline skidders.
*Will skidding pay in India ?
*Choice of skidding systems in India.
List of manufacturers of machinery.

Introductory.

27. If logging railways take the first place in importance in lumber operations in North America, the next place must be given to steam skidders, or " donkeys " as they are often called. It may indeed be open to argument that they should come first, as the big timber operations are associated with them more than anything, for it is commonly supposed that Western logging is chiefly a matter of manipulating powerful engines that are capable of hauling big logs, or themselves as the case may be, for long distances, through any sort of undergrowth and over any kind of obstacles.

Such a picture would have been more correct ten years ago than it is today. For, in addition to collecting individual logs together from stump (or " Yarding " as it is termed) it used to be a common practice to haul the logs for long distances along the same track (Skidway, Pole road, etc.), by steam power to cartroad, railway or river. For this work special machines with extra long ropes (and known as " *Road* " *Engines*) were designed.

This type of skidding has however gradually declined in importance with the development of railways. Experience has shown in hundreds of instances that railways can be profitably carried so far into the fellings that logs can be brought to them from stump in a single operation.

The description of modern skidding appliances and methods given in this chapter is rather a long one, because it has been thought desirable to touch upon all the more important details of the subject, instead of simply referring the reader to " Logging." The writer found it rather hard to follow Mr. Bryant's description, and it was not until it had been supplemented by visits to several lumber camps that anything like a clear picture of skidding operations in general presented itself.

Other methods of hauling logs.

28. Important, however, as skidders and ropeways are, it must not be supposed that they are universally used, and that every log is pulled from stump by them. This is very far from being the case. Rolling of logs by hand, dragging along the ground by animals, hauling on sleds or on wheeled vehicles drawn by horses, steam engines or motors, all have their place, and between them probably handle something like half the outturn.

In the same connection it may also be noted that, although lumbering in America is usually associated with big operations, a rather striking example can be given of primitive methods, so widely practised as to play a large part in the industry.

Railway sleepers.

The allusion is to railway sleepers, over 75 per cent. of which are cut with the axe. The sawing of sleepers is of secondary importance altogether. The supply of hewn sleepers is chiefly in the hands of men with small capital, cutting only a few sleepers from dead and refuse trees and carting them to the nearest railway depot. Farmers also supply a good many at slack times of the year.

Description of skidders.

29. Skidders are simply hauling machines specially designed for handling logs. The boiler, engine and rope drums are assembled on a steel frame so that, when placed on a suitable mounting, the whole machine can be moved about and operated as a self-contained unit. The number, rope capacity and gearing of the drums depend on the class of work to be done.

The principal rope is the *Skidding Rope* which does the hauling of the logs. It varies in diameter from ⅜" to 1⅛". As 3,000 feet of ¾" rope weighs over a ton it would obviously be too slow a business, and take too many men, to think of hauling the mass of rope back into the woods by hand for the next log. The engine is therefore relied upon to do this *out-hauling* (*rehauling*), and is provided with an extra drum and rope for the purpose. The general arrangement is as follows. The "Skidding" and "Out-hauling" drums are on separate axles geared to the engine. Both axles revolve all the time that the engine is running, but the turning of the drums on them depends on whether the latter are locked to the shafts or not. Clutch levers are provided for the purpose. On arrival at a station the first step is to pull the outhaul rope (which is only half as thick as the skidding line) into the woods to a pulley block fastened to a tree at the far end of the run, and then to bring it back home again. It is then tied to the hook on the skidding line. With the outhaul drum locked and the skidding drum free, the engine is started, and out the skidding line goes to the woods. To bring another log in all that has to be done is to reverse the clutch levers on *both* drums.

In respect to the machines themselves there is a wide range of difference in the details, although they all bear a close resemblance outwardly to each other. It is the same with the accessory fittings; for example, the skidding rope may pass direct from a log to the drum, or it may be led through one or more blocks on trees, stumps, etc., or on the frame work of the machine itself.

A machine which deserves special mention is one made by the Washington Iron Works Company, and known as the *Simplex Two-Speed Yarder*. The speed of the drums can be changed up or down whilst the engine is running. It is claimed for the machine that the rate of hauling logs is thereby increased. So far as the writer is aware this is the only machine in which the variable speed idea is embodied.

Methods of skidding.

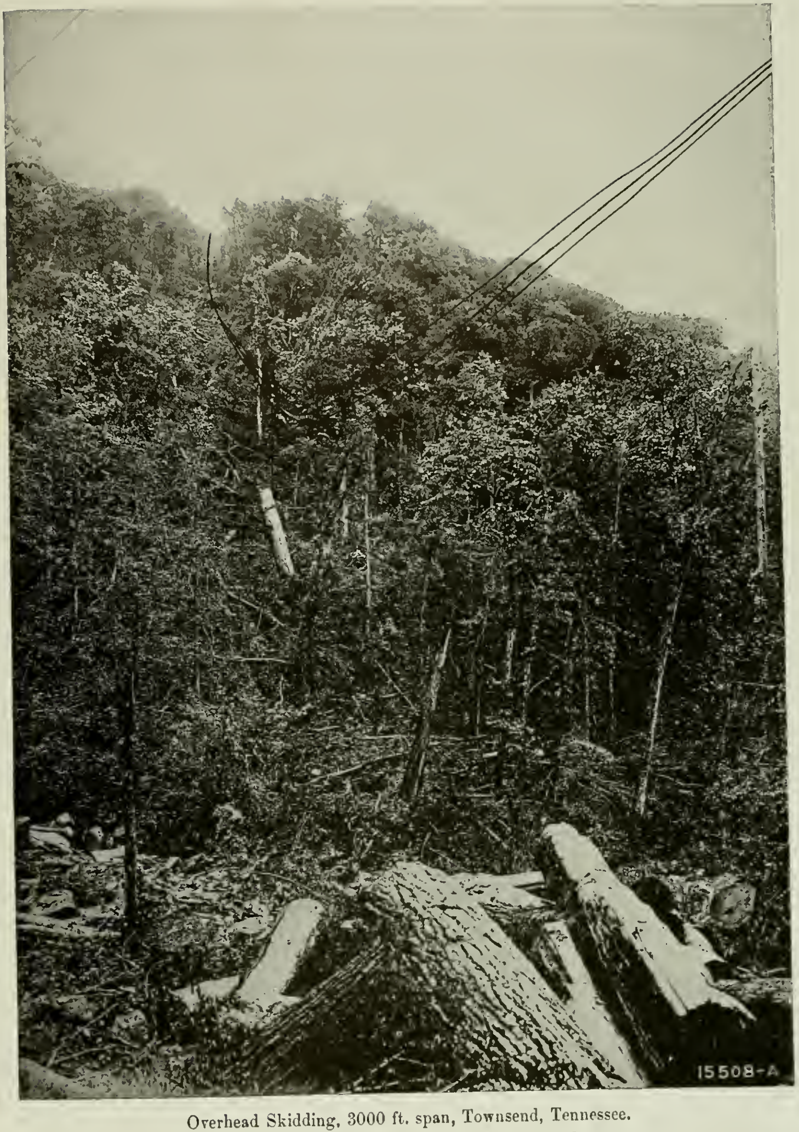
30. Three methods of using skidding machines are practised, *viz*:—

(*a*) *Ground or Slack Rope Skidding.*—With all the ropes directly on, or close to, the ground.

(*b*) *High Lead Skidding.*—With the hauling rope passing over a pulley block fixed to a support from 80 to 180 feet above the ground near the machine.

(*c*) *Overhead Skidding.*—With a log carrier running on aerial cable.

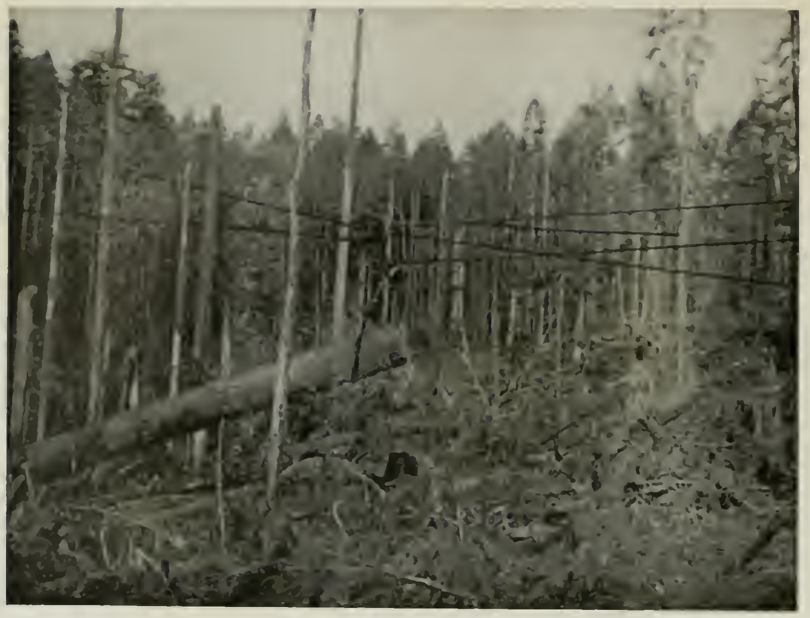
Plate XVII.



Overhead Skidding, 3000 ft. span, Townsend, Tennessee.
(Presented by Messrs. the Clyde Iron Works Co.)

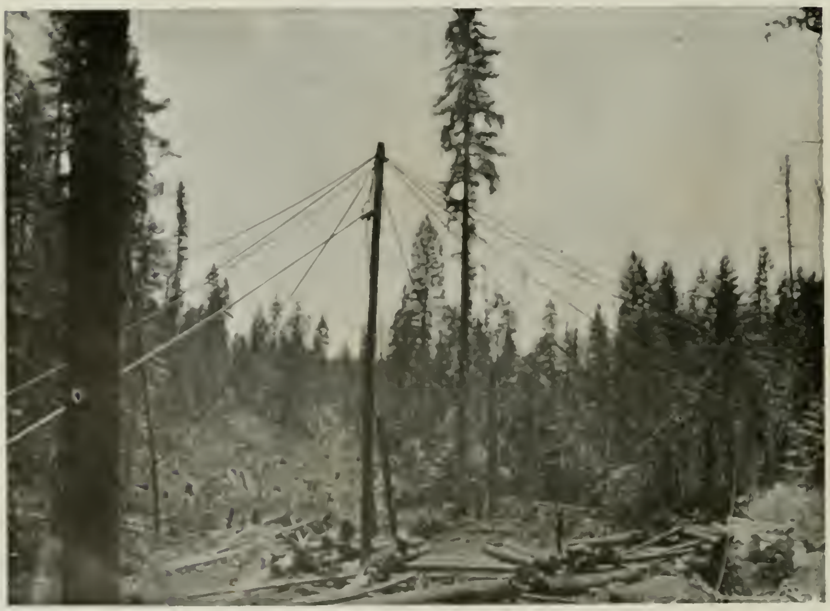
(para 30).

Plate XIX.



OVERHEAD SKIDDING.

(1). Span 1200 feet; nose of log well off the ground.—Lake Cowichan, B. C.



HIGH LEAD SKIDDING.

(2). Head Spar tree in the centre; mechanical outhauling; strip of forest being logged on the left; loading on the right;—Keeler, Idaho.

(para. 30).

It may help to keep the types clearly in mind to remember that the " Ground " type has all the ropes on the ground, that the " High Lead " has one end of the rope raised to a considerable height above the ground, and that in the " Overhead," system the other end of the rope is also raised, and the rope itself is held tight with the load running along it suspended from a carrier.

The great drawback to ground skidding is that the logs so easily jam against roots, stumps, rocks and other obstructions. Not only do logs tend to plough into the soil, but rubbish and earth collect in front, thereby increasing the pull on the engine considerably.

The High Lead method of elevating the skidding rope gets over this difficulty to a large extent, as logs ride over obstacles easily. Advocates of the system claim that much less grit works its way into cracks in the surface of logs to cause trouble later on in the mill ; saws last longer without re-sharpening.

The Overhead plan is obviously the best of all in this respect, as the logs can be lifted clean off the ground.

In the term Overhead skidding all forms of aerial ropeways are included, with or without intermediate supports.

It is simpler to think of skidding operations as being divisible into three types, although it is not the universal practice to do so.

Many operators look upon the High Lead method as being simply a special form of ground skidding. This is quite true, but it would be equally correct to look upon it as a modified form of Overhead skidding. To help a log to ride over an obstruction the driver puts his foot on the out-haul brake lever. By putting a strong drag on the outhaul rope the load can be lifted clean off the ground ; in fact the rig becomes, momentarily, an Overhead one with the Tail Block low down close to the ground. In a type of machine very much used, and often spoken of as a Boom Skidder, the hauling rope passes through a block at the end of a boom or jib, either fixed or moveable. As the height of the block from the ground is usually not more than 20 feet, skidding with the machine is practically of the Ground type. The contrivance is chiefly useful in facilitating the piling of logs into big heaps. In some cases the boom is considerably longer, and the skidding approaches the High Lead type.

Effective hauling limits ; Relay skidding.

31. The effective limit for High Lead Skidding is from 600 to 800 feet. Hauling beyond this distance is under the same disadvantages as ground skidding. The actual limit in any particular locality depends on the slope of the ground and the size of the Spar Tree to which the Main Haul Block is fixed. At New Bern N. C. the trees are so small that the block is only about 60 feet from the ground. In the Douglas Fir forests on the Pacific Coast it is common to have the block 120 to 180 feet up.

The cutting of the top off one of these big spar trees is a very impressive sight. If the top were not cut off there would be danger of its breaking off afterwards and doing damage. The top is a fair sized tree in itself, as the cutting off is done at the place where the diameter is about 20 inches.

The massiveness and unwieldy character of the appliances used by the High Lead operators in the big Redwood and Douglas Fir forests on the Pacific Coast may be gauged from the fact that the main pulley block, 120 to 150 feet up in the air on the Spar Tree, weighs anything from 600 to 800 lbs.

The Range of a Ground Skidder simply depends on the size of the drums, the strength of the ropes and the power of the engine. In practice the limit is about 3,000 feet. Where railway construction is easy and the "Stand" of timber is good enough, it pays to have shorter hauls. The writer saw several examples of Boom Skidders operating to a distance of not more than 800 feet. It is much the same in the Cypress Swamps. The machines on the Pull-boats at Donner, La, for example, are capable of hauling logs for a distance of half a mile. In practice the saving of time involved in limiting the hauling to a quarter of a mile is so great that it is found to pay to face the extra expense thereby required on canals.

The range of an Overhead Skidder depends on the heights of the Head and Tail Blocks relative to the ground between them. On flat ground, with the Head Block 70 feet up and the Tail Block 50 feet, the practical limit is about 800 feet.

Across valleys and deep ravines 3,000 feet spans are common, as it is possible to allow the cable to sag sufficiently for safety, even with heavy loads. Single spans of 4,000 feet have also been operated successfully.

With intermediate supports the length of a permanent aerial system can be extended indefinitely. The necessity, however, for shifting the line at short intervals, in the course of a logging operation, will impose limits to the length that can be economically employed. A mile is about the limit in America at present. The intermediate supports are usually placed about 800 feet apart.

An example was seen in the operations of the Rutledge Lumber Company, Keeler, Idaho.

On easy ground, however, it is the same with overhead skidding as it is with ground skidding, *viz.*, extra railway construction is cheaper than long spans.

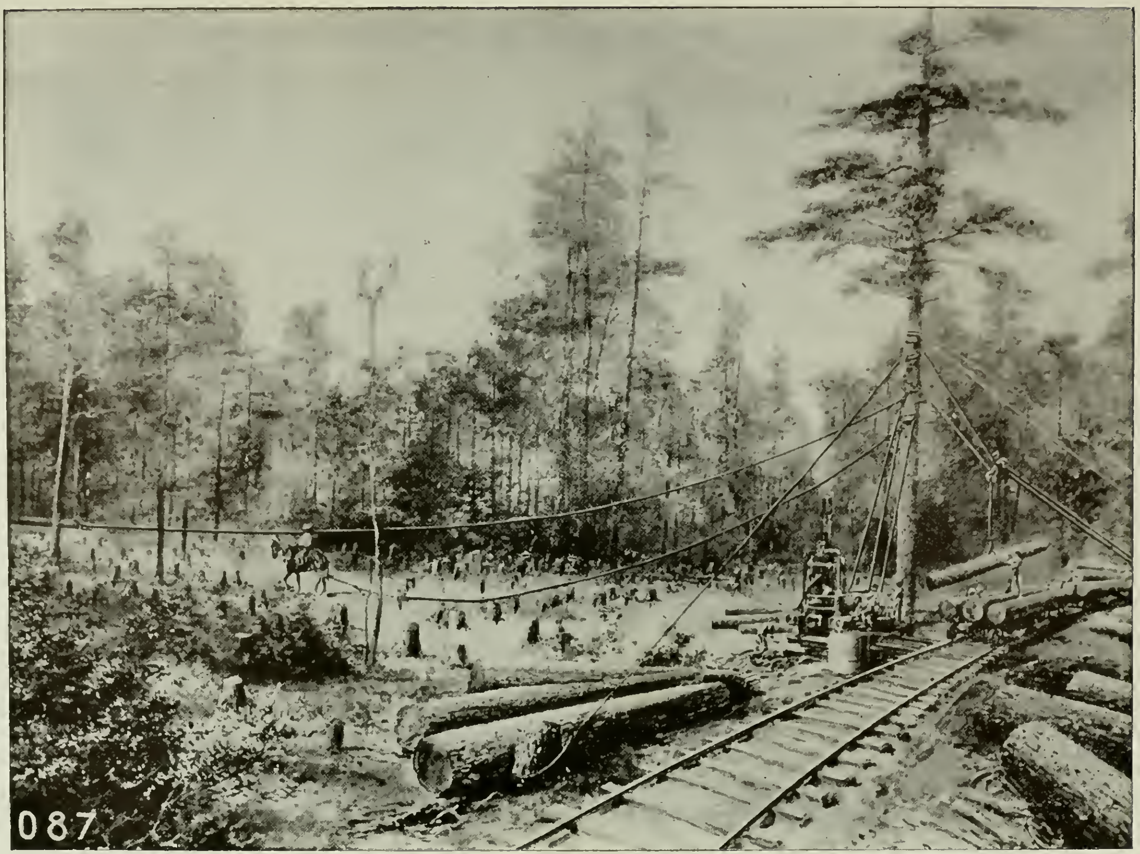
One special type of overhead skidding with one or more intermediate supports is very common. It is known as "*Relay*" *Skidding*. It may, for example, be desired to skid across a ridge from one valley to another. In such a case a spar on the ridge to hold up the cable would be necessary.

Or it may be desired to log a side valley running off from the main one where the skidder is stationed. Here also an intermediate support would be required, *i.e.*, in the angle.

With such a method of rigging the logs would first of all be hauled to the relay tree and piled in a heap there. The carrier would then be shifted to the near side of the relay tree, and the logs be picked up again and be brought in home.

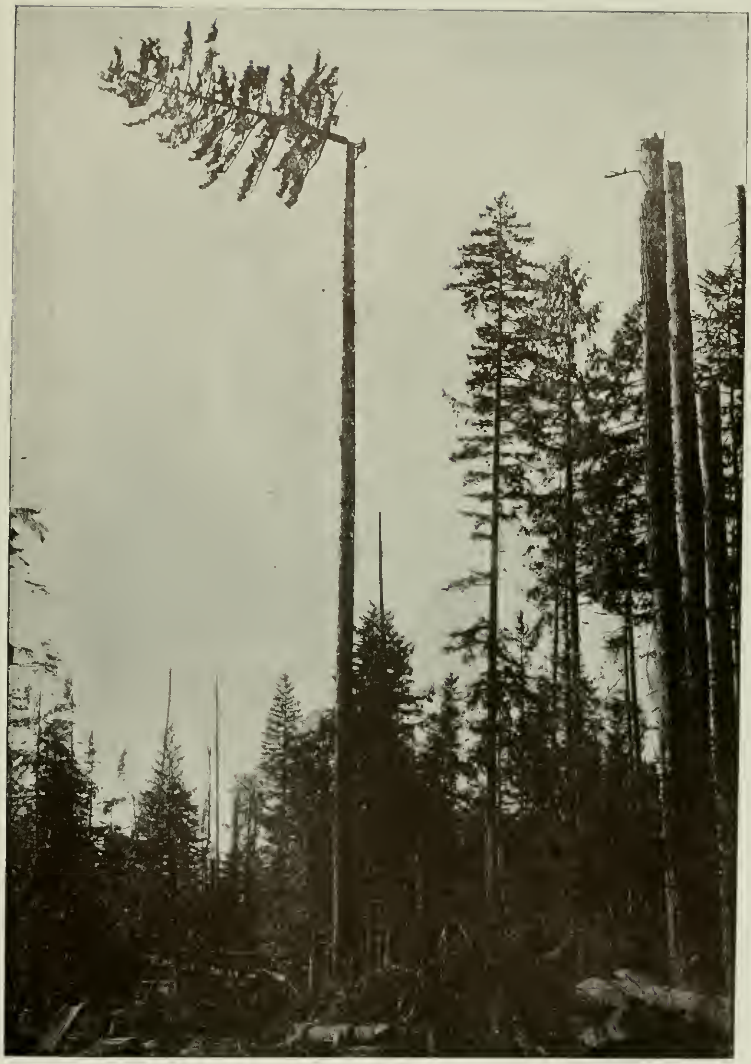
It may be noted that hauling round a corner can also be done by the Ground system, by passing the skidding rope through a block fixed to a support in the angle. It cannot, however, be done with High Lead skidding.

Plate XX.



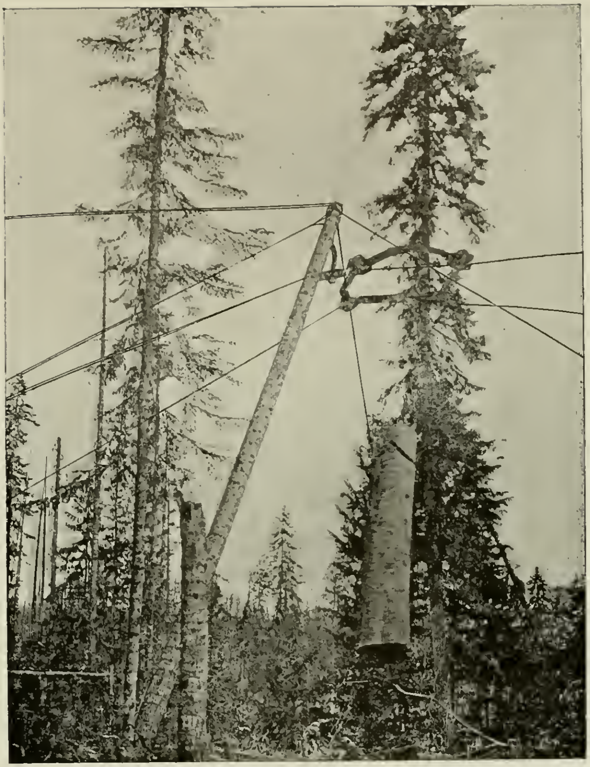
High Lead Tree Spar Skidding and Guy Line Loading.
(By permission of Messrs. The Lidgerwood Manufacturing Co.)

(para 31)

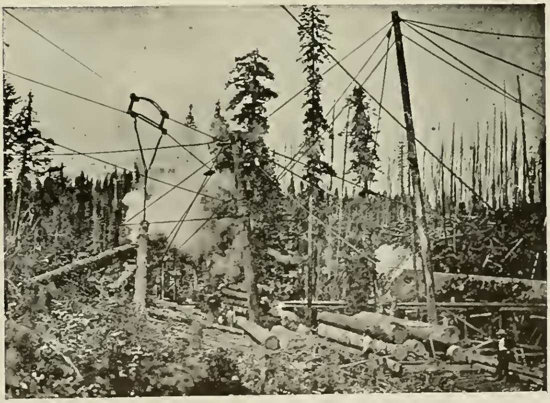


HIGH LEAD SKIDDING.
Cutting the top off a head spar tree 180 feet above the ground.
(Presented by Messrs. The Washington Iron Works Co.)

(para 31).



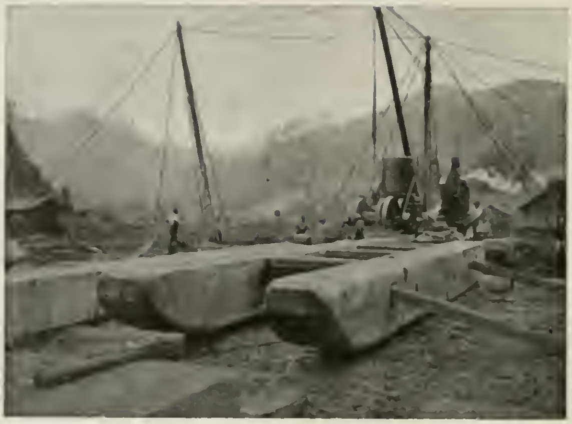
(1). Intermediate support of 3,500 feet overhead rig ;
log just passing.—Keeler, Idaho.



(2). Same as above at railway end of operation ;
the smaller of the two spars is used for loading.—Keeler, Idaho.

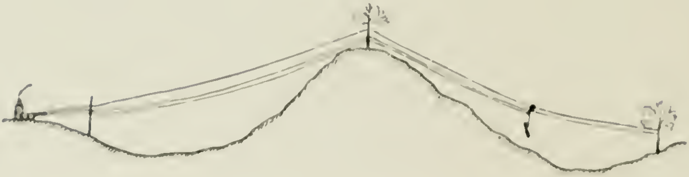
(para. 31).

Plate XXIII

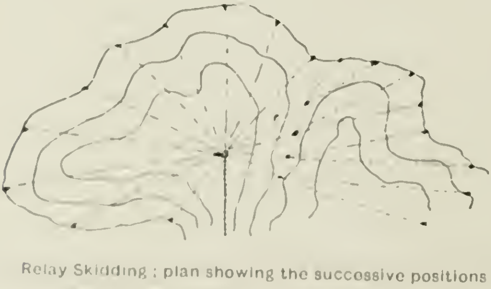


Timber skids for Skidder ; 40 feet × 2 feet × 2 feet
Fort Bragg, California.

(para 32).



(1). Relay Skidding ; diagrammatic section.



(2) Relay Skidding ; plan showing the successive positions of the relay and tail trees round the setting in the middle.

(para 31)

32. The method of mounting skidders depends on whether they are to be used on, or near, a railway or not. In the latter case they are always mounted on a pair of big timber skids braced together. Anchored in any place a machine can pull logs to itself. If it stands free and the skidding rope be placed and fastened to anything, on putting in the clutch the whole machine will move forward.

Mounting and setting of skidders.

It is a common sight to see machines on skids at work near railways; but instead of the slow method of self-haulage to a new station or setting, time is saved by hauling the machine on to a car and using a locomotive.

Such machines are, however, more or less old fashioned and modern mounting takes the form either of a special car or of a platform that can be placed on one.

The machine may either be side-tracked to leave the line clear, or it may remain on the railway line itself. In the latter case the style of mount depends on whether the machine is to do loading as well as skidding or not. If it is only required for skidding it can be allowed to operate on an ordinary car on the track. But it would be a serious handicap to adopt such a method for combined skidding and loading. Provision must be made for moving empty cars past the machine; otherwise loading would have to stop at frequent intervals and a locomotive would be required in constant attendance to shunt the loaded cars, one by one, on to a siding and bring forward empty ones.

This difficulty is got over by jacking the platform up on blocks high enough to allow empty cars to pass underneath, and yet stable enough to permit of working the machine. All the principal manufacturers of logging machinery make both timber and steel mounts of this type.

The Clyde Iron Works Co. also turn out three machines of a special type, which are self-propelling and do not need to be placed on an ordinary car for transport, *viz.*:—

(1) The McGiffert Loading machine with its wheels on frames which can be hinged up under the platform. The legs of the latter are high enough for empty cars to pass through.

(2) The "Universal" Combined Skidding and Loading Machine with the wheels on fixed frames and a space between them and the underside of the platform for cars to pass through. Extra rails are provided to connect with the track on both sides.

(3) The "Decker" Combined Skidding and Loading Machine of much the same pattern as No (2).

The simplest way of side-tracking a car is to put in a temporary length of track and to remove the switch after the car has been moved on to it.

Interference with the railway track is avoided by the following method. The car is jacked up high enough to permit of swinging the bogie frames round through a right angle. Spare rails are placed under the wheels and rest at their other ends on the length of side track the machine is eventually to stand on. The car is then lowered on to these cross rails and moved across to the other set, where it is placed in position.

Machines on timber skids are usually heavy enough to dispense with special anchorage, but this has to be attended to in the case of boom skidders. Guy lines are run from the boom to suitable stumps or trees.

Outhauling of skidding rope.

33. The carrying of the skidding rope back into the wood for a second log is done either by animal power or by the engine. If the outhauling (or "re-hauling") is done mechanically, an extra drum is provided on the machine to carry a rope double the length of the maximum yarding distance. This rope is only half the size of the skidding one. Such extras add to the cost of the machine, and on fairly flat and dry ground, free from underbrush, outhauling by horse or mule is preferred. At Bogalusa, La and Sweetville, La, the writer saw good examples of the use of animals—mule and horse respectively.

At New Bern, N.C., mechanical outhauling is preferred, because of the density of the undergrowth and the swampy nature of the ground.

It goes without saying that in the Cypress Swamps the engine has to do all the pulling out of the ropes.

All overhead systems also have mechanical outhaul.

Development of skidding system.

34. Although Overhead skidding came in first yet it did nothing for a time beyond paving the way for Ground skidding.

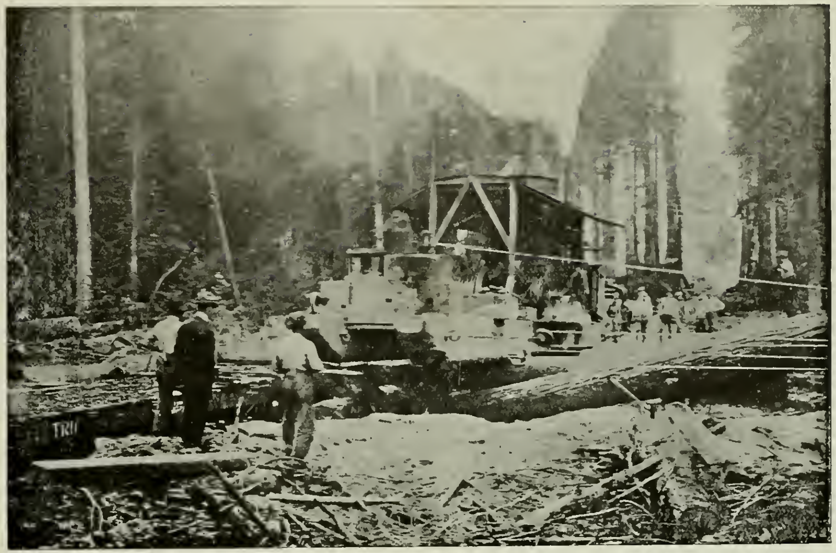
The latter soon came into existence and was first favourite for many years. The part played by Overhead skidding at that time was comparatively unimportant. Further, the High Lead system did not then exist. It originated on the Pacific Coast in comparatively recent times, and is easy to understand as a simple development of the old Ground system.

Nevertheless, it is quite correct to say that Overhead skidding has first place to-day. This rise in favour is believed to have come from two directions, viz., from the Douglas Fir forests in the west and the Cypress Swamps in the south.

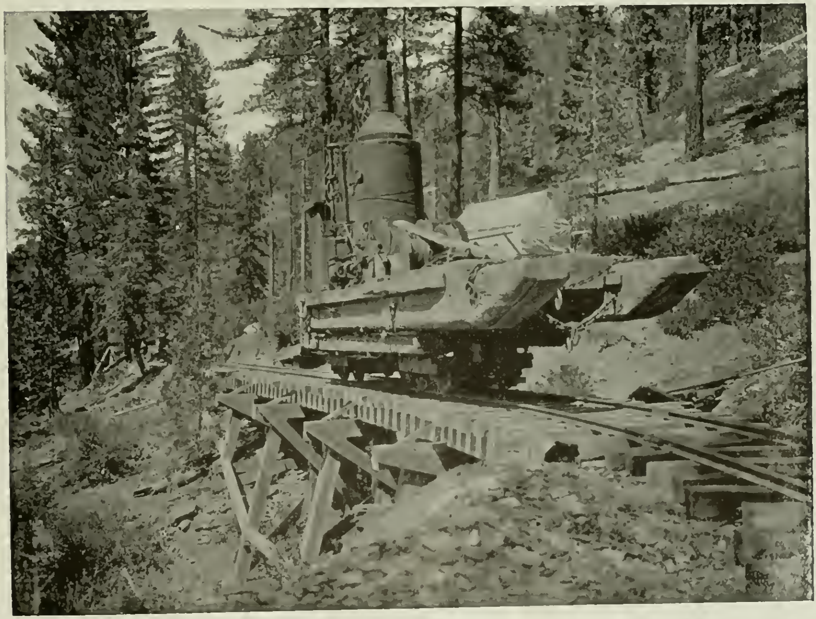
The difficulties in the way of hauling big logs on the ground, either up or down such steep slopes as are to be found on the Pacific Coast, are very great, and logging men have been led to invent several different ways of moving the logs overhead.

The change that has taken place in the Cypress Swamps is remarkable. From 10 to 15 years ago lumbering in these forests was in rather a bad way. The cost of pull-boat skidding and canals was so heavy that only those tracts could be worked at a profit which were well stocked and within easy reach of natural channels.

Owing chiefly to the enterprise of the Lidgerwood Manufacturing Co., New York, Overhead skidding and rail transport were introduced, and have proved to be remarkably successful. The industry received a new lease of life as the reduction in working expenditure made it possible to work areas which were hitherto unprofitable. A contributing cause is the fact that Red Gum and other species are now taken out, whereas formerly everything but Cypress was left behind. The success of the change in system is the more noteworthy because the length of haulage has been halved. The pull-boat skidder operated—and still operates in places—up to a distance 1,500 feet, whereas the Overhead skidder does not go beyond 700 feet. The mileage of railway track is therefore fully double that of the canals.



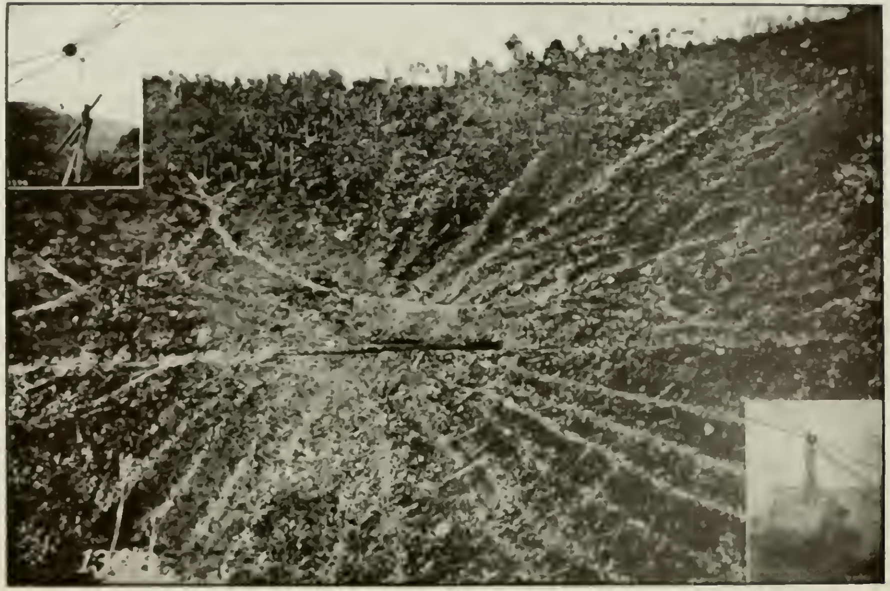
(1). Skidder mounted on timber skids hauling itself sideways off a railway car at a new setting; New Westminster, B. C.



(2). Transporting skidder by rail on 3-feet track.—Lamoine, California.

(para 32).

Plate XXV.



View of a Setting after completion of Logging :

Note the hauling of logs in any direction from direct uphill to direct downhill.

(By permission of Messrs. The Lidgerwood Manufacturing Co.)

(para 36).

Relation between time of felling and skidding.

35. Overhead skidding has an advantage over Ground skidding in that it is so much more independent of the fellings. If all the trees were felled and logged for a depth of 800 to 1,200 feet from the railway before hauling commenced, it would make no difference to the Overhead operator, but it might seriously handicap a Ground man, as there would be so many more opportunities for the more distant logs to tie themselves up in stumps and refuse. For this reason it is a common practice in ground skidding to run the felling for a setting of the machine only a day or two in advance of the skidding.

Preference for uphill skidding.

36. At first sight it might be supposed that skidding logs down a slope would be easier than hauling them uphill. This is not the case with Ground and High Lead skidding, because the logs tend to over-run, and either unhook themselves or jam up against trees or other obstructions. This trouble is aggravated when the hauling is being done on the skew, *i.e.*, not straight down the slope.

On this account it is a sound rule, when planning a logging railway, to run the spurs as high as possible up the slopes, instead of keeping them low down in the valleys. As the length of the lines is likely to be increased thereby, the skill of the logging engineer shows itself in striking the correct balance between the railing and the skidding parts of the operations.

With Overhead skidding there is far greater latitude as it makes very little difference whether the hauling is up or downhill.

Damage to forest growth.

37. Overhead skidding compares favourably with the other methods in respect to damage to forest growth, but there is no getting away from the fact that any form of skidding with such powerful and long range machines does a lot of damage. Saplings and poles are heeled over, snapped in two or torn up by the roots, and trees left standing get badly scraped. Formerly this destructiveness hardly entered into the thoughts of the lumberman at all, but in more recent years, thanks chiefly to the efforts of the Forest Service, a better spirit is beginning to show itself.

The ploughing up of the soil should not however be looked upon as injurious always. It helps regeneration. A good example can be given; in the Coconino National Forest, Arizona, a Clyde Boom Skidder is in use, with a range of 1,300 feet. The logs are hauled by horses and Big Wheels, and piled on lines at right angles to the railway and a furlong apart. The skidder hauls the logs to the railway along these lines, and in doing so turns up the soil for a width of 30 to 50 feet as effectively as a harrow. Slopes are very easy but the ground is decidedly rocky and the soil is poor in consequence. The forest is very thinly stocked with Yellow Pine and reproduction is poor.

The idea in the marking done for the firm by the Forest Service is to leave enough trees for a second cut and also for natural regeneration. For the latter purpose the tracks made by the skidder are excellent and it is a pity that the strips are not closer together. A skidder can indeed do the work of a steam plough if desired.

Life and weight of machines.

38. The makers of logging machinery pride themselves on turning out machines capable of standing any amount of rough usage. This proud attitude is justifiable, for skidders and cars are mercilessly treated by lumber-jacks and yet they last indefinitely. Breakages are comparatively rare—except in the case of ropes. The writer came across several machines that had been at work for ten years or more and are still quite good.

It is the general rule with lumbermen to count on a machine lasting as long as the operation for which purchased. More machines are scrapped because they are out-of-date than because they are worn out. Makers are constantly bringing out improvements and, if they are likely to pay, operators do not hesitate long before going in for them.

The price paid for these lasting qualities is of course a heavy one, and especially in respect to weight. The machines are indeed heavy, and the tendency is to make them still heavier owing to the desire to get more and more out of them.

Rough handling is unavoidable, *for fast working is essential. One of the first things to be taught drivers in India is not to be afraid to open the throttle wide.* Ropes must be made to travel at top speed even if, in so doing, the machine rattles all over and rocks about alarmingly. Machines cannot turn over and it is astonishing what good ropes will stand without breaking.

The weights of machines are approximately as follows according to size :—

(1) Loading machines on steel frames	3 to 12 tons.
(2) Yarding machines on steel frames	6 to 16 tons.
(3) Road machines on steel frames	10 to 20 tons.
(4) Clyde Overhead Skidding and Loading machine on railway car	50 to 70 tons.
(5) Lidgerwood Overhead Lowering Steel Spar Skidding and Loading machine on railway car	50 to 100 tons.

Ropes and tackle are not included. Nos. (4) and (5) are ready for use ; Nos. (1) to (3) require to be mounted on timber skids or cars.

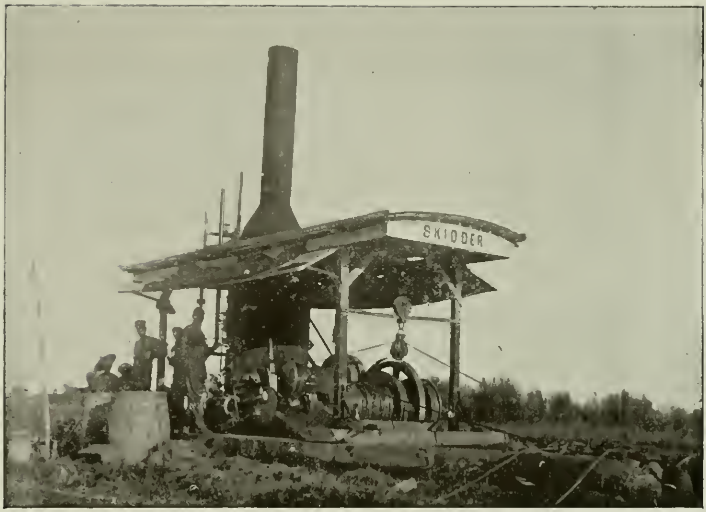
The weights of machines depend on the size of the logs, the length of haul and the amount of work the engine is to do in the putting up of the skidding rig. The modern tendency is to make the engine do as much as possible to save manual labour.

The simplest and lightest machine is a single drum loader.

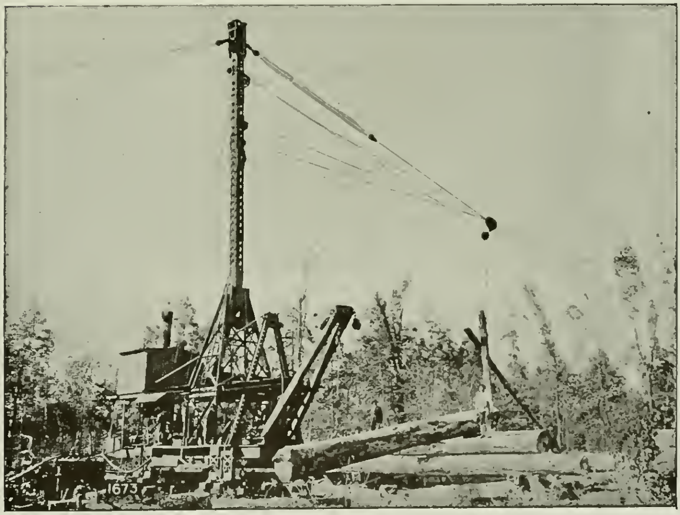
In practice skidders never have less than two drums. The Washington Iron Works 2-drum machine purchased by the Forest Department in Burma in 1913 may be taken as an example of the simplest and lightest make of skidding machine in use in North America now-a-days. Its weight, including the timber skids and a full boiler, etc., is about 21 tons. The weight of the machine only (ironwork) is about 9 tons.

As an example of the heaviest and latest type of machine the Lidgerwood Combined Skidder and Loader of the Lowering Steel Spar type may be mentioned.

Plate XXVI.



(1). 2-drum ground skidder purchased by the Forest Department, Burma, in 1913, from Messrs the Washington Iron Works Co.



(2). Lidgerwood Overhead Skidder, lowering steel spar type, with swinging loading boom.

(para. 36).

The smallest size weighs 50 tons when at work and there are the following drums :—

1 engine with 4 drums for skidding outhauling, slack pulling, and lowering the spar.
1 engine with 4 drums for the main cable (2 drums) changing lines and spotting cars.
1 engine with 4 drums for the four guy lines.
1 engine with 3 drums for loading.

Total 4 engines and 15 drums.

It must not be imagined that this multiplication of engines and drums tends to make the machine complicated and difficult to handle properly. Such a supposition would be altogether misleading. The number of drums in operation simultaneously during skidding or loading is no greater than in any other make of machine. The extra engines and drums are simply provided for facilitating the rigging up, control and taking down of the guy lines and overhead cable. To change lines at a setting only takes a few minutes. In many instances not more than twenty minutes have elapsed between the arrival of the last log in one position of the cable and that of the first log in the next position.

This Lidgerwood is undoubtedly the best overhead skidding, and loading machine in the world to-day. If it were not for the high price charged for it no other type would stand a chance against it in the majority of the big lumber operations anywhere.

Life and weight of ropes.

39. Ropes are an expensive item in the working of skidders. Unlike the engines their life depends very considerably on the treatment they receive. In fact the skill and trustworthiness of a driver are judged a great deal by the length of time his ropes last. Ropes in constant use and given fair treatment should last about as follows :—

Overhead cable (1⅛″ to 1½″)	2 years.
Skidding line (¾″ to 1⅛″)	9 months.
Outhaul line (⅝″ to 1″)	6 months.
Slack-pulling line (½″ to ⅝″)	1 year.
Pilot line (⅜″)	2 years.

Dimensions given are diameters. The shorter life of the outhaul line is due to the fact that part of it is always out and cannot be lubricated without dismantling the whole rig.

Weights of Wire Rope (approx.).

	Tons.	*Cwt.*
3,000 feet of 1¼″	3	6
3,000 feet of 1⅛″	2	13
3,000 feet of 1″	2	2
3,000 feet of ⅞″	1	12
3,000 feet of ¾″	1	4
6,000 feet of ⅝″	1	13
6,000 feet of ½″	1	1
6,000 feet of ⅜″	..	12

Output.

40. It is difficult to give definite figures for the amount of timber a skidder can haul. It depends on the type of machine, the length of the haul, the size of the logs, the stand per acre and the topography of the locality. Loggers pay more attention to the total volume rather than to the number of logs. Small logs are taken two or more at a time, but they require more handling and the outturn is smaller than with big logs.

The following examples are selected from the writer's notes :—

At Townsend Tenn., in a hilly track and small stand of about 15 tons per acre, a Clyde Overhead, with a span of 3,000 feet, can bring in 60 logs cubing 40 tons a day.

At Elk, Calif., in the big Redwood forests, a Sky Line Overhead rig, with a span of 2,700 feet, brings in *and loads* 100 logs cubing 200 tons a day. This is remarkably good and is probably above the average of a long period.

At Bridal Veil, Ore., in big Douglas Fir stands on easy slopes, a Ground skidder, operating for a distance of 1,400 feet, averages 75 logs cubing 150 tons a day.

A good opportunity was afforded at Donner, La, of comparing two methods.

Ground skidders working on pull-boats in the Cypress Swamps bring in from 10 to 12 logs at a time for a distance of 1,500 feet. Each log has to be hooked on separately, and a good deal of time is taken up with short pulls backwards and forwards to attach the whole string of logs. On an average it takes about an hour to bring in a full load and run out for the next one. The daily average is 120 logs cubing 80 tons.

The Lidgerwood Overhead skidder operated by the same firm in another part of their tract, under similar conditions, only brings in from one to three logs at a time, but it only takes about five minutes for a double trip. A fair average is 240 logs cubing 160 tons a day.

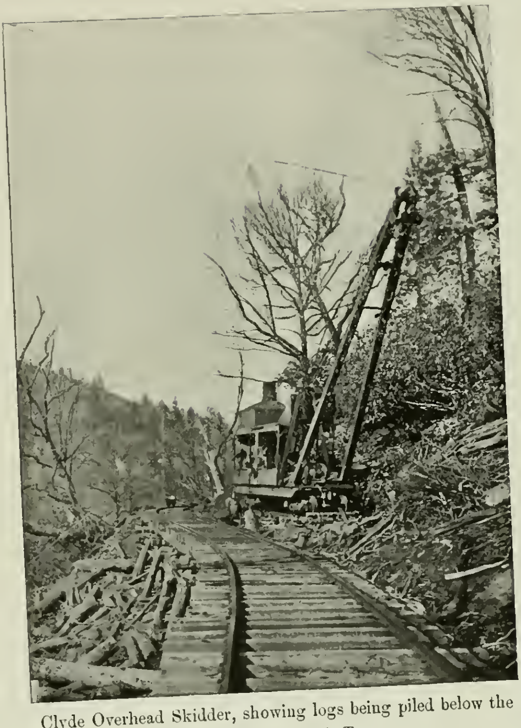
Even with the same machine there are great variations from day to day according to the nature of the stand. It was put as follows to the writer at Townsend, with reference to the Clyde Overhead rig already mentioned : —

The cableway is operated fan-wise round the machine set on the railway. Having hauled in all the logs within reach of any one position of the cable (or " Road " as it is called) the cable is shifted to the next radius, and so on. The worst type of forest the firm considers worth operating in is one yielding an output of only 100 logs a week, and with two, and only two, " roads " before shifting the skidder to a new station further along the railway.

The best type they have yields 60 logs a day for a whole month without change of " road ", and with at least four " roads " for a single setting of the skidder.

When studying the figures of outturn already given, it should be remembered that the logs are picked up all the way along ; the average haul is therefore only about half the maximum. As a rule logs travel faster overhead than on the ground. Of course it is possible to have such big ropes and such powerful

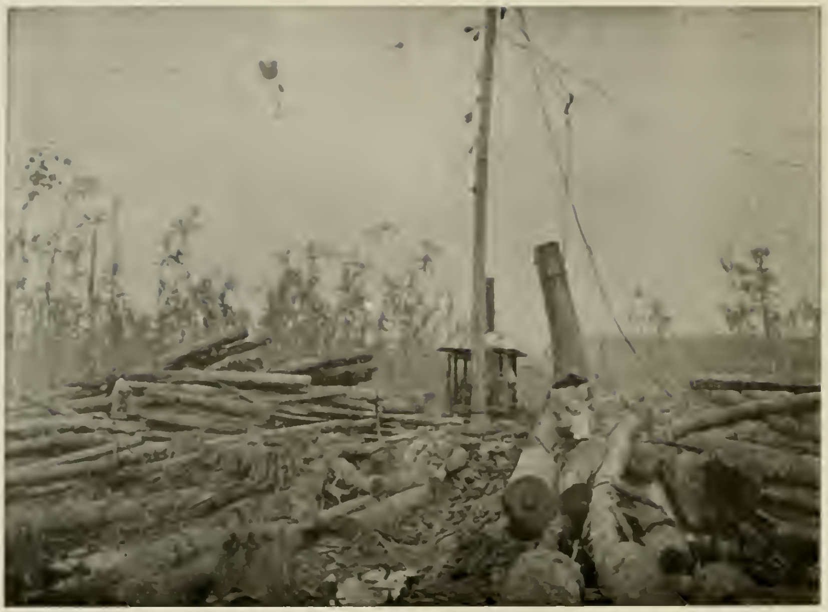
Plate XXVII.



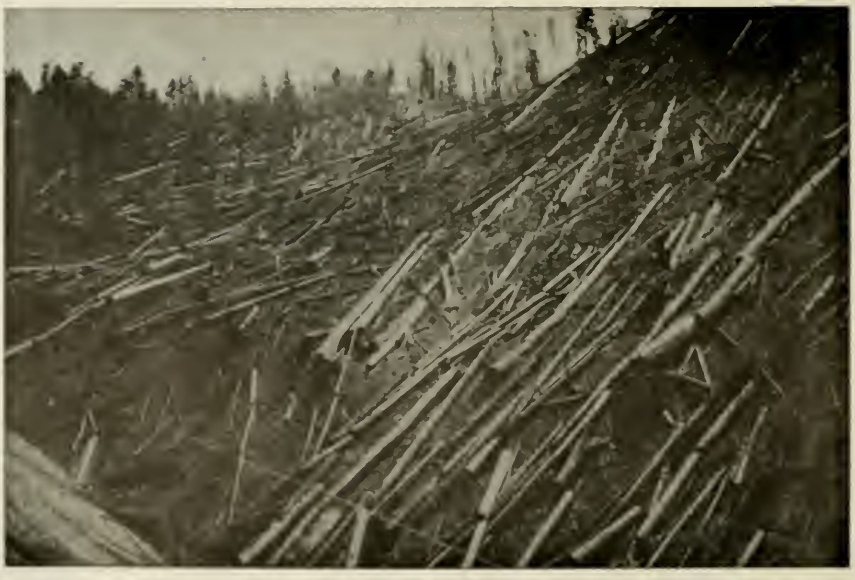
Clyde Overhead Skidder, showing logs being piled below the railway track,—Townsend, Tennessee.

The overhead cable passes through a block at the top of the 2-legged boom and thence to one of the Skidder drums; the boom is held in position by guy lines.

(para. 40).



(1). OVERHEAD SKIDDING IN CYPRESS SWAMPS.
Span 700 feet ; Skidding Carrier just starting out ; log being loaded suspended from Guy Line.
Lutcher, Louisiana.



(2). LOGGING IN THE GIGANTIC REDWOOD FORESTS OF CALIFORNIA.
Felling and burning of bark and brushwood completed ready for Skidding, many of the logs over 6 feet in diameter ; yield from 200 to 400 tons per acre.—Fort Bragg, California.

(para 40).

engines, that logs—especially heavy ones—can be driven through anything at top speed. This is believed to be one reason why the Ground and High Lead machines on the Pacific Coast are such big and unwieldy monsters. Moreover, it goes without saying that the damage to tree growth is considerable in the Douglas Fir forests.

The best results with a skidding outfit are obviously obtained when all the loads of logs are as close as possible to the safe limit of weight. This means bringing in small logs 3 or 4 at a time, and it needs no argument to show that it is easier, and therefore safer, to do so overhead than on the ground.

In an ordinary type of mixed forest, an Overhead rig with a span of 1,200 feet could be relied upon to bring in 100 average logs a day, the actual number of course depending on the variations in size. *This average would be independent of topography,* within very wide limits. With Ground skidders the case is very different ; their outturn depends very considerably on the nature of the ground. A fair average would be 75 logs under favourable conditions, dropping to 50 logs, or even less, in bad hills, thick stands or dense undergrowth.

One common way out of the difficulty with small logs is to bring them in as long as possible, and to leave cross-cutting to be done at the landing, or even at the mill itself. The latter method has decided advantages, but it necessitates the use of long cars. No general rule can be laid down. When making plans for a logging operation one of the first things to be settled is the question of length, both for logs and for cars.

Time required to move skidders.

41. The foregoing figures of outturn are exclusive of the time required to shift a skidder from one position to another. This may be anything from a few minutes to a whole day, according to the type of machine. It never takes more than a day or two if the stations are on, or close to, a railway. On the other hand, if a skidder is operating away from a railway, and has to depend on hauling itself about, a long time is required to travel any distance. Two miles a day would be a good average on easy ground with all arrangements made beforehand.

It is essential for successful operation independently of railways that the stand will permit of long halts, and also that successive stations are near to each other. Further, the good and the bad must be taken together, as it would not pay to return to an isolated portion of a forest. Before starting work at all detailed study of a whole operation must be made.

With a railway system as the basis of an operation the task is much simpler. Provided that Spur tracks are ready, it makes very little difference how far off the next station may be. The Manager can, to a large extent, work each individual setting at the most convenient time, both in respect to the season of the year and the requirements of the mill and market.

Combinations of skidders.

42. At the beginning of this chapter the statement is made that the use of skidders for " Road " work, or hauling logs for long distances after being previously "yarded ", is now becoming obsolete owing to the development of railways. It is still practised to some extent, and the writer came across several interesting examples.

The Empire Lumber Company, Vancouver Island, *B. C.*, are operating on slopes leading down to Lake Cowichan. The timber is skidded into the lake and rafted 12 miles to the terminus of the nearest railway, and thence it is railed some 30 miles to its destination. At the time of the writer's visit to camp No. 2, skidding was being conducted in three stages. The problem before the Manager was the logging of the slopes facing the lake, the greatest distance being about 3,000 feet at the top of the ridge. The slopes are everywhere steep except on the tops of spurs, and for a short flattish bit running irregularly at about 200 yards from the lake. The soundness of the choice of a big tree on this terrace as the Head Spar for the Lidgerwood Overhead rig was obvious. The position of half a dozen " roads " radiating from this tree showed up very plainly. The drums and cable, however, only permitted of a span of 1.200 feet, so a ground skidder was sent up one of the spurs to work round, yarding logs at the top until they were within reach of the Overhead. Lastly, a third machine was installed to haul the logs from the foot of the Spar trees into a slide, down which they shot into the lake.

Another example was seen at Lamoine, California in Yellow Pine. There is a considerable difference in elevation between the mill and the highest part of the track. The railway (3 feet) runs at a good distance up the slopes now being logged. A ground skidder yards the logs down below, and a Boom skidder hauls them up to the railway and loads them.

Labour saving devices.

43. From what has already been said it can readily be understood that there has been plenty of room for the exercise of ingenuity in improving the efficiency of skidding machines. Some of the more valuable contrivances are described below. They are chiefly concerned with saving time and manual labour, for the latter is such an expensive item. The time spent in setting up a machine, in taking it down, or in removing it to a new station, is all lost time so far as output is concerned.

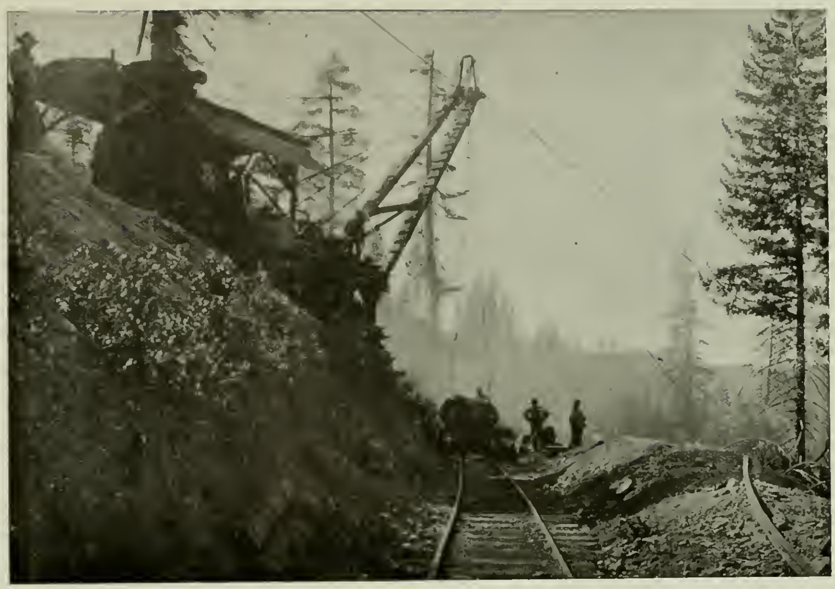
Pilot and spotting lines.

44. In rigging up a machine one of the chief things to be done is the getting the ropes and blocks out into the wood. To drag 6.000 feet of outhaul line ($\frac{5}{8}$") by hand with half a dozen men would be a slow business, the weight of this length being over one and a half tons. A smaller rope known as the " Pilot " line, and usually $\frac{3}{8}$" in diameter, is kept in stock for the purpose : 6.000 feet of it only weighs about 12 cwt. It is hauled out by men or by animals, passed round a block at the far end and brought back home. It is then tied to the outhaul rope and wound in. This plays out the outhaul line, which in turn can be made to pull out the skidding line or overhead cable as required.

For moving cars backwards or forwards during loading operations there is usually an extra drum on the machine, carrying a $\frac{1}{2}$" rope known as the " Spotting Line"

Skidding cones.

45. The attachment of a steel cone to the nose of a log makes a wonderful difference in Ground skidding. The writer saw them in use at Sardis, Miss. The logs wormed their way in and out through bushes, and over or under other logs in a remarkable manner. Whereas without them there would have been plenty of

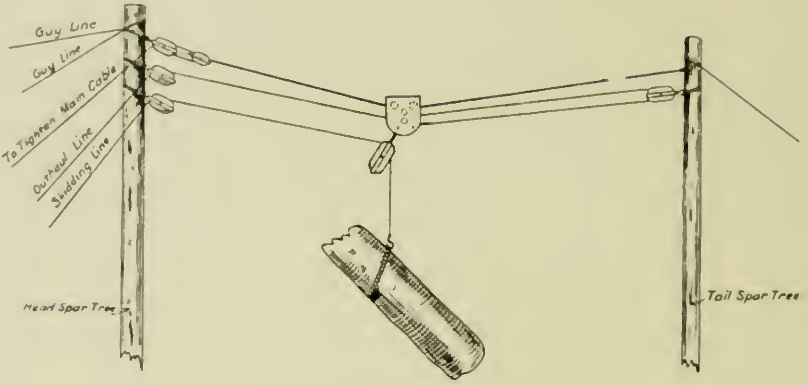


(1). Willamette Boom Skidder and Loader ; 3 feet track ;—Lamoine, California. (para. 42).

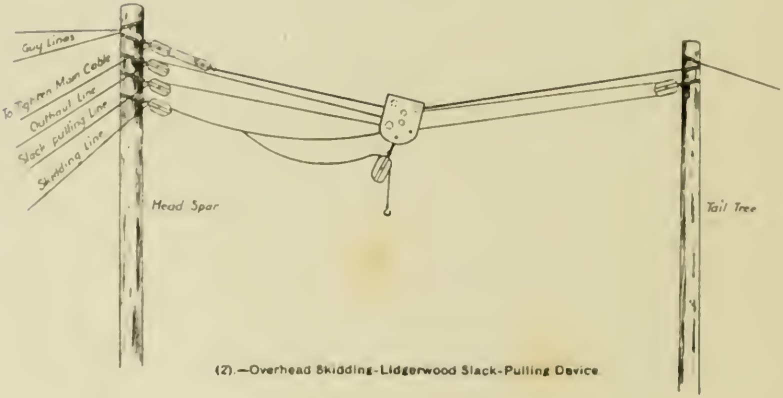
SKIDDING WITH CONES.

(2). Log just in home, piling done near railway track ; loading done separately ;—Sardis, Mississippi. (para 45).

PLATE XXX.



(1).—Overhead Skidding-ordinary type.



(2).—Overhead Skidding-Lidgerwood Slack-Pulling Device.

(para 46)

stopping and re-starting, with the use of the cones the logs came right in home without a halt.

The use of cones is not general. They necessitate the employment of tongs and, if for any reason the engine stops and the rope becomes slack, the tongs are apt to drop off and have to be put on again. For logs of different diameters cones of different sizes are required, and unless the cones themselves are very strongly made they soon get badly knocked out of shape.

Slack pulling.

46. The usual method of rigging up the ropes for Overhead skidding is as shown in the accompanying diagram. The skidding line passes over a pulley block or wheel attached to the carrier, and the latter is pulled out to the wood by the out-haul rope. Whilst the carrier is running out the skidding line is allowed to unreel freely. The hook on the end of the skidding line soon gets drawn right up to the carrier, and is held there by the weight of the loop of rope between the carrier and the machine. The weight of this loop of slack rope soon becomes considerable (500 feet of $\frac{3}{4}''$ rope weighs 4 cwt.). When the carrier has been stopped over the next log to be hauled, it is not an easy problem to get the hook down if the cable is more than a few feet up in the air. Supplementary to heavily weighing the hook three ways of doing it are in vogue : —

(*a*) To allow the carrier to overrun a little, and then to bring it back sharply with the idea of jerking the hook down. This usually means wasting time in making two or three attempts, if the writer's experiences at Townsend, Tennessee are to be taken as normal.

(*b*) To attach a length of thin rope to the hook and allow it to hang freely. The carrier is allowed to over-run a little before being stopped. The dragging rope is then tied to any convenient stump or tree. The carrier is then run back some distance. This pulls the hook sufficiently for it to remain down when the carrier is stopped and run forward again.

(*c*) *The Lidgerwood Slack-puller.* Comparison between the two diagrams should make it easy to follow the working of the method.

An extra drum is provided on the machine and an extra pulley wheel on the carrier. These are for an extra rope (known as the "Slack-pulling" rope) which is fastened to the skidding line about 100 feet from the hook end. Procedure is as follows :—

The carrier is run out as before, with the skidding rope slack, and also the extra or slack-pulling one. After stopping the carrier the clutch of the slack-pulling drum is put in. This causes the other end of the slack-pulling rope to travel up towards the carrier, thereby allowing the hook to drop.

This simple contrivance is universally admitted, even by other manufacturers of machinery, to be far and away the most efficient of the three methods in use. The right to use it is the exclusive property of the Lidgerwood Manufacturing Co., New York. For the sake of this one advantage alone, other things being equal, Lidgerwood skidders are to be preferred to all other makes for

Overhead skidding of the ordinary type. It is to be noted that there are other overhead methods in which the question of slack pulling does not arise, as, for example, in the MacFarlane (Sky Line) system described later on. None of these other methods are in anything like such general use as the ordinary, or running hook, type.

Interlocking drums.

47. To understand the nature of another valuable patent held by Messrs. Lidgerwood it is necessary to give a short description of the mechanism of skidding machines. Although machines on the market differ from each other in size and general appearance, yet they all have their winding mechanism arranged in one of two ways. One method is to be found on Lidgerwood Overhead skidders, and the other on all other makes.

(a) *General Type.*

The engines are not reversible: the crank shaft only revolves in one direction. The pinion on this shaft meshes with geared wheels on the skidding and outhaul shafts. *The latter do not mesh with each other.* Both shafts therefore turn in the same direction, and are always in motion so long as the engine is running.

The drums float freely on the shafts and have friction cones at one end. By means of levers the drums can be moved sideways, locking or unlocking with the gear wheels as the case may be.

The ropes are coiled on the drums in the direction which will cause them to wind up when the engine is running with the clutches engaged. Un-winding, or playing out of the ropes, is done by taking out the clutches (*i.e.*, unlocking them) and thereby allowing the drums to free-wheel.

It follows from this arrangement that when the skidding rope is being hauled in the outhaul clutch must be out, and the only means of controlling the playing out of the outhaul rope is by the brake lever. This arrangement meets all requirements for Ground skidding, and is present in all machines built for the purpose (including Lidgerwoods).

The case is different with overhead skidding of the ordinary type. From the description already given of the winding mechanism, it may be gathered that the only thing which prevents a log from dropping to the ground whilst the carrier is travelling homewards is the friction put on the outhaul drum by the hand-brake lever. The driver must allow the clutch to keep slipping, or else the log would rise in the air and jam up against the carrier. In that case, if the engine did not pull up, something would have to give way, the outhaul in all probability.

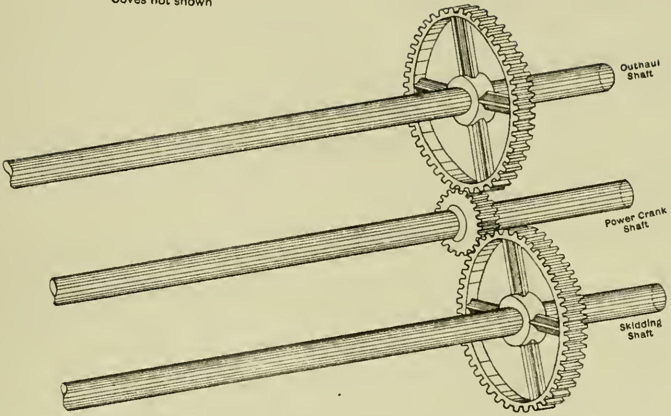
The steadiness with which the load travels forward depends entirely on the skill of the driver. In practice there is always a certain amount of bumping on the ground. The log comes in home in a series of leaps and bounds.

(b) *Lidgerwood Type.*

The engine is the same as usual, *i.e.*, not reversible. The patent lies in the number and meshing of the geared wheels. There are two extra ones, as the crank

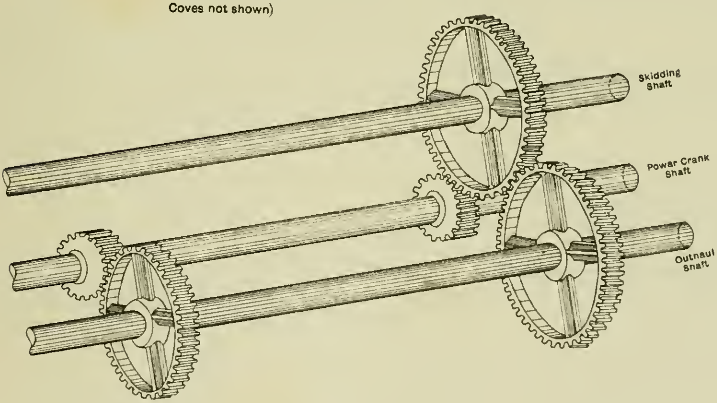
PLATE XXXI.

Rope drums and friction
Coves not shown



(1).—Gearing of Drum Shafts—Ordinary type of Skidder.

(Rope drums and friction
Coves not shown)



(2).—Gearing of Drum Shafts—Lidgerwood Interlocking Drum type.

(para 47)

and outhaul shafts each of them have two geared wheels instead of one only.

The pinion at the right hand end of the crank shaft (*vide* diagram) meshes with the wheel on the skidding shaft; *it does not mesh with that on the outhaul shaft. But the wheels on this end of the skidding and outhaul shafts mesh with each other.*

The other pinion on the crank shaft meshes with the other wheel on the outhaul shaft (left side, *vide* diagram).

The two wheels on the outhaul shaft turn in opposite directions when the engine is running. Both of them cannot, therefore, be keyed to the shaft. The one on the right is permanently fixed to the shaft; the other is free.

There are friction cones at both ends of the outhaul drum. With the lever in the neutral position the drum floats freely. By throwing the lever over to the right or to the left, the drum can be locked to whichever geared wheel is desired.

As in the general type all the shafts and geared wheels are in motion all the time that the engine is running.

The ropes are coiled on the drums in the direction which permits of their being wound up by the engine with the clutches on the right engaged.

Whilst the carrier is running out to the wood procedure is as before, the right hand outhaul clutch being in, and both the others being out. As soon as the carrier is ready to start homewards the outhaul clutch lever is reversed. Both drums are now absolutely locked together, and as soon as the engine is started they begin to revolve in such a way that the rope on the outhaul drum uncoils as fast as that on the skidding drum is wound up. The load has therefore no tendency to drop and can be held at any desired height above the ground.

This Lidgerwood interlocking drum mechanism is undoubtedly of great practical value. Not only does the load travel more steadily but the demand on the engine is reduced, thereby saving steam.

NOTE.—In this explanation of the working of the interlocking device the fact that the drums may not be coiling and uncoiling respectively, at the same rate, is ignored. It is to some extent allowed for in the gearing, and the driver can let the clutch slip slightly as required — a small matter in actual practice.

Other labour-saving devices.

48. The visits to operations were of such short duration that there was no time to take in everything to be seen. Undoubtedly longer study of selected operations would have brought to notice a number of useful labour and time saving devices. Even for the experienced logger new problems are constantly turning up and call for the exercise of skill and ingenuity. Amongst other devices that came to notice the following may be mentioned—

(*a*) The Washington Iron Works Simplex Two Speed Yarder.—(*vide* paragraph 29).

(*b*) The Lidgerwood Multiple Skidding Lines.—These lines are about 40 ft. long and carry running rings to which hooks can be attached. They are used for small timber, when it is desired to bring in several logs together.

(*c*) Loggers Electric Steam Signal Whistle.—Made by C. M. L. Lovsted and Co., Seattle, Wash.

The old method of signalling was to attach a light telegraph wire to the engine whistle and to run it out to the wood. Signals were given by tugging at the wire. It had to be kept fairly tight and was liable to get in the way and be broken. The Lovsted patent is an electric trigger device for pulling the whistle lever. It is operated by a small battery. The wire can be placed well out of the way and gives quicker signals.

The whistle is a comparatively recent invention which has already become a general favourite on the Pacific Coast. The writer saw several of them in operation. It is claimed for the whistle that it saves time and thereby increases the output.

(*d*) Telephone Signals, At Elk, Calif.—The writer saw a plan that worked very well indeed. Logging was being done on the Macfarlane (Sky Line) overhead system, with 2 skidders close together on the top of the hill, and the cableway reaching right across the valley (2,700 feet) to the opposite hill. The railway was down below on the same side as the skidders. The signalman was stationed on the track near the car being loaded. Skidding (yarding) and loading were being done in a single operation. The signalman not only had a good view of the men engaged on attaching the slings but, being near the track, he could give full attention to the loading. The track being a narrow gauge one and the logs being very large (up to 10 tons) a good deal of adjustment was often necessary to get the loads properly balanced.

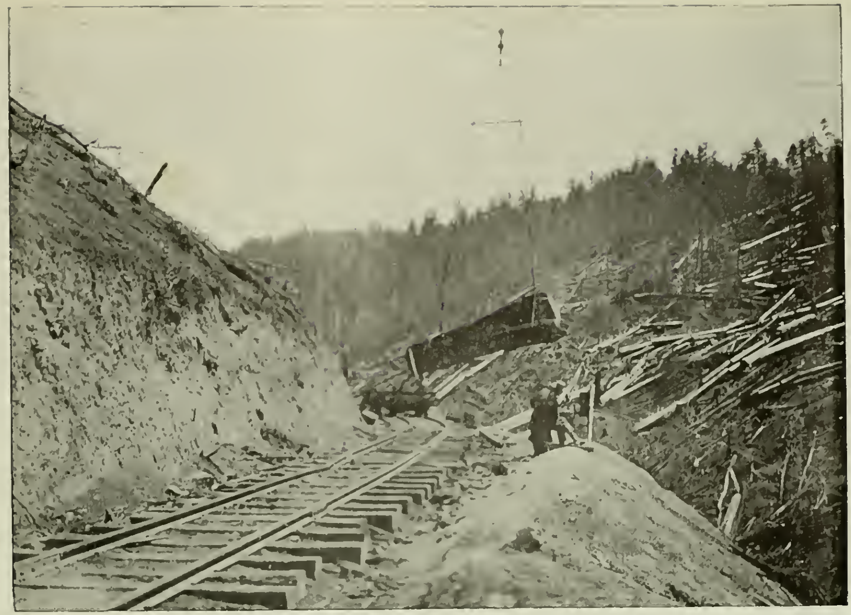
Macfarlane (Sky Line) Overhead system.

49. At Elk, Calif, the writer saw an Overhead rig in which the lowering of the hook to the ground is done by slackening the Overhead cable itself, instead of by running the skidding line through a block attached to the carrier. The method is known as the Macfarlane System. At Elk it is called a " Sky-Line " rig, but this term is often used elsewhere to include any or all types of overhead skidding.

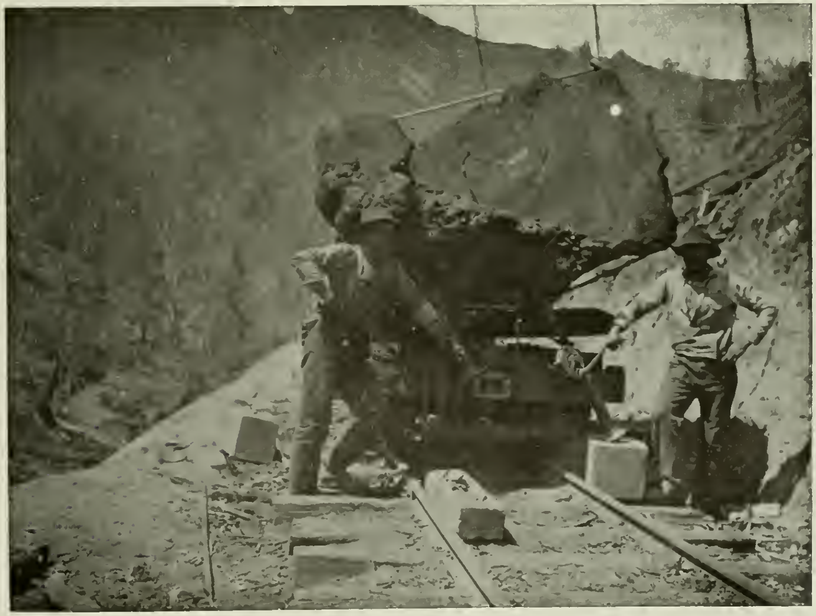
About 2 years ago one such rig was installed with the idea that it would be an improvement on the High Lead method then in use. The experiment has proved so successful that the putting up of a second rig was taken in hand a short time ago. The general idea is as follows. Both the skidding and the outhaul lines are attached to the carrier. From the latter a pair of hooks are suspended. The hooks are raised or lowered by hauling in, or playing out, the overhead cable or "sky line."

The actual outfit is somewhat more complicated than the above, as the sky-line is double.

The cable (1") passes from the drum through one wheel of the carrier, round a tail-block on the opposite hill and back through the other wheel of the carrier to an anchorage near the skidder. To keep the cable from chafing against the cheeks of the carrier, in case the latter turns upside down when no load is on, additional wheels are inserted for the cable to rest upon.

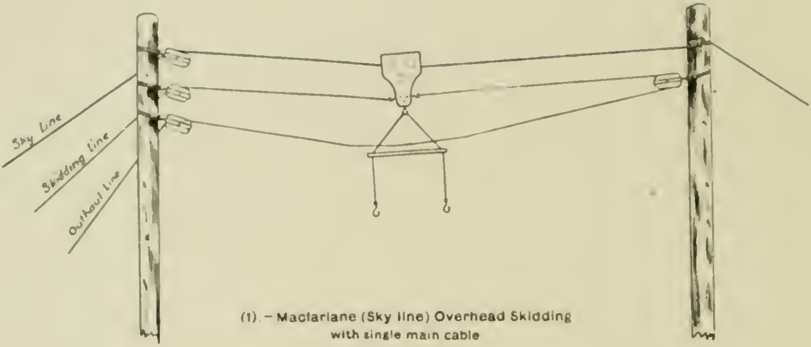


(1). SKY LINE SKIDDING AND LOADING.
8 ton log on 3 feet track ; telephone operator in the foreground.—Elk, California.

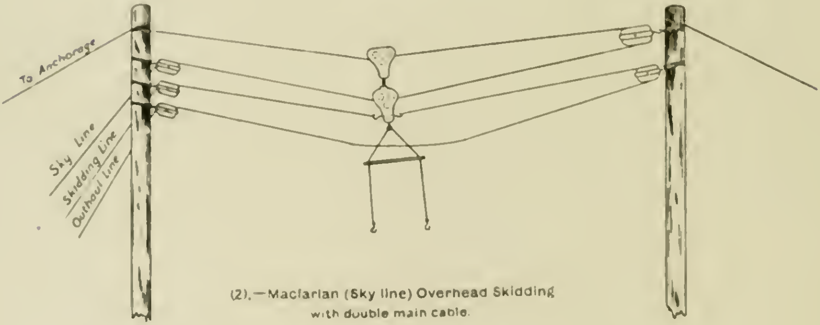


(2). Same as above, near view after the log had been deposited on the car ; note the use of hand jacks to make the log balance properly.—Elk, California.

(para 49 .

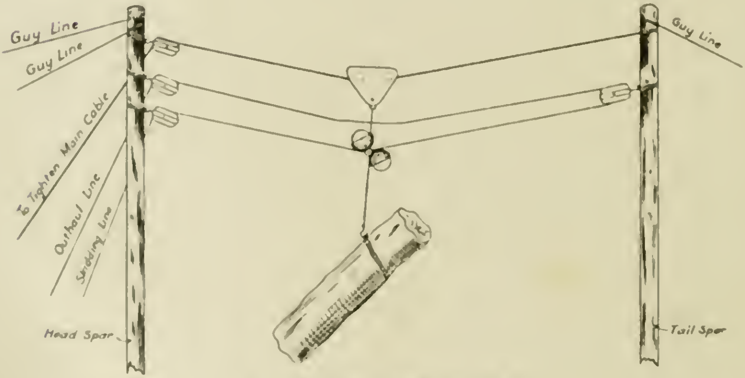


(1). – Macfarlane (Sky line) Overhead Skidding
with single main cable



(2). – Macfarlan (Sky line) Overhead Skidding
with double main cable.

(para 49)



(3). —North Bend Overhead Skidding.

(para 50)

The strain on the overhead cable is great, and the use of such a light one as 1" is only possible because the valley is so deep that the line can be allowed to sag considerably. There is a drop of 500 ft. between the skidders and the railway track. The Manager believes that he gets better results from the double line than he would from a single one twice the size.

North Bend Overhead system.

50. Some years ago the North Bend Lumber Co, Wash invented the system which goes by their name. An approach to the idea would be obtained by reversing the methods of attachment of the skidding and outhaul lines in the ordinary system.

The carrier runs freely on the overhead cable. The block which carries the hook is supported by the skidding line. The outhaul line is fastened to the same block. Supposing a log lying on the ground is hooked on—as soon as the skidding line begins to be hauled in, if the outhaul drum is held by the brake, the log begins to rise off the ground.

The system is said to work well, although it is believed not to be very widely used. The writer saw it in operation at Fort Bragg, Calif. It is difficult to see what special advantages the system possesses. It is described in this report chiefly as a curiosity.

Other Skidding systems.

51. In the foregoing part of this chapter the principal methods of rigging up the ropes for skidding purposes have been touched upon. Seeing, however, that blocks and tackle are made of many sizes and can be fitted together in any number of different ways, it would be a matter for surprise if the skidding systems already described were the only ones experimented with, or in use, in any part of Canada or the States. Notwithstanding the excellence of modern skidding machinery and equipment, nobody would care to say that nothing better could be invented. Experiments are constantly being tried. Notices of them frequently appear in the various lumber journals and are well worth study by anyone interested in the subject. Reference may also be made to the catalogues of manufacturers of logging machinery and equipment, noticeably F. B. Mallory and Company, Portland, Ore.

Electric and Gasoline Skidders.

52. The writer only heard of one electric skidder, and that was not at work at the time of his visit to the Portlatch Lumber Co. Elk River, Idaho. It is believed that a type of motor suitable for logging has been evolved. It would be worth while making further enquiries, if any good opportunity for using electric power presents itself.

Up to date gasoline (petrol) has not been tried for driving skidders.

Will steam skidding pay in India ?

53. It is hoped that the foregoing notes and photographs will be sufficient to give a general idea of what skidding machines look like, and how they work, but before proceeding to discuss the possibilities open to such machines and appliances in India, one remark is added, to show how large a part skidders play in the lumber industry in the continent of North America.

If it is true—as stated in chapter II—that railways dominate the logging operations, it is equally true to say the same of steam skidding machines, for logging railways are everywhere associated with them and are often left behind by them, as steam skidding can be done in places where railway construction would be prohibitive.

Although it is perfectly true to state that there is no tree growing in any part of India (or anywhere in the world for that matter) which could not be handled by a modern skidding machine, yet it by no means follows that it would pay to use skidders all over India.

The first point it is desired to make is that power skidding, independently of rail or water transport, is becoming obsolete in North America even in rich "stands" of timber, and so cannot be recommended in India at all. Too much time is taken in moving about, and this would be fatal with the relatively poor "stands" of timber so common in India.

The main field for the development of skidding is expected to be with railways; although suitable localities possesssing good water carriage also exist, as for example the Andamans and the Irrawaddy Delta.

To come to a final decision as to whether railway skidding will pay in India involves consideration of the following factors:—

(*i*) Topography.

(*ii*) Stand of timber and intensity of felling.

(*iii*) Climate.

(*iv*) Labour and Staff.

(*v*) Price of Machinery.

(*vi*) Selling rates for timber.

As the last item (*vi*) is at present an absolutely unknown quantity final decision must necessarily be postponed. With regard to the other items the following additional observations are made:—

Topography.—does not matter much at all; modern skidders are equal to anything, and in difficult country the extra expense is more with the railing rather than with the skidding.

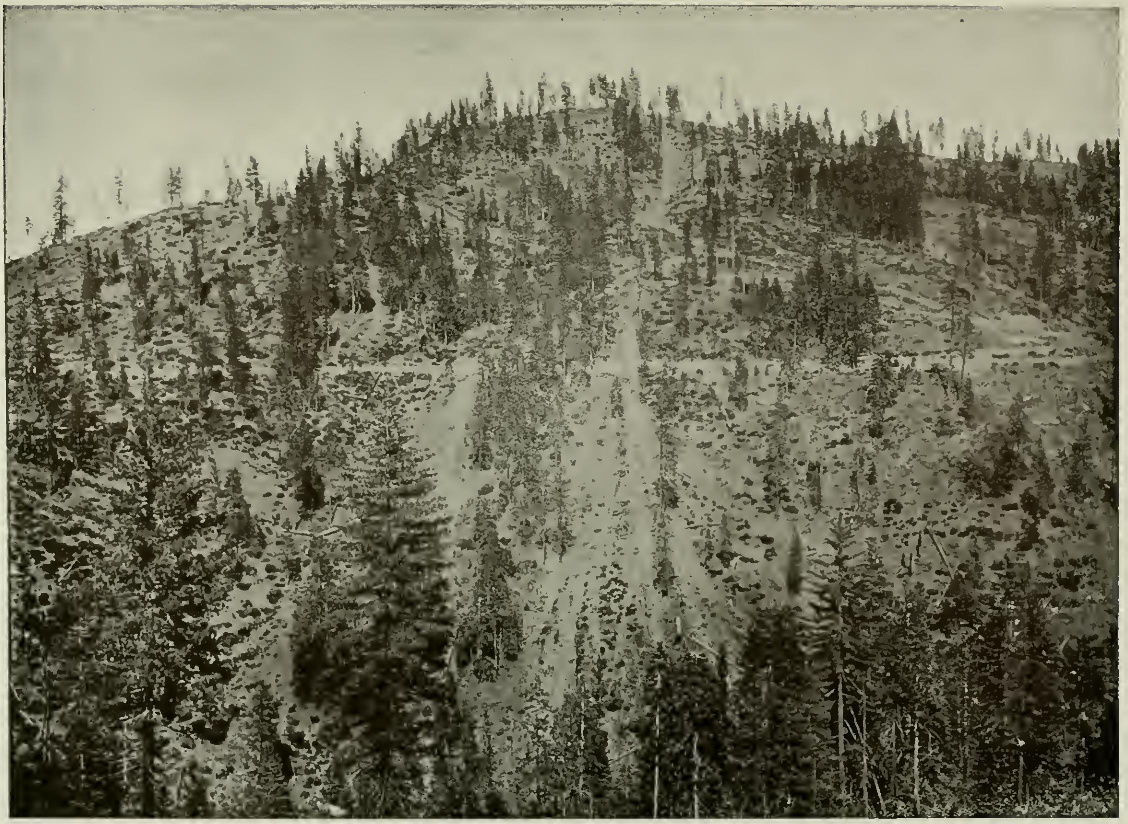
Stand of Timber and intensity of Fellings.—Selective logging used to prevail in the Southern Cypress Swamps (only one species being taken) but it was still fairly intense according to Indian ideas and, even so, the use of skidders has only survived because the fellings have become still more intense (or far less selective).

There are many examples to be found of skidders successfully operating with a yield of not more than 10 tons of timber per acre, and locally not more than 5 tons.

Turning now to India, the case may be stated as follows:—

If not less than half to two-thirds of the "stand" (merchantable sized timber) is taken in a single operation, there are many localities where these limits would be reached. Incidentally it may be noted that it would not pay to bring skidders back a second time, to take away the balance of the "stand," unless the latter was also above the minimum limit.

Plate XXXIV.



EXAMPLE OF VERY GOOD LOGGING IN NATIONAL FOREST :
Yellow Pine, Skidding finished, yield 20 tons per acre;
Skidding station in centre of picture alongside 3 feet track ;
Small trees left standing by order of the U. S. Forest Service,
and care taken to do as little damage as possible to them—Lamoine, California.

(para 53).

If therefore anything has to be sacrificed, it would be better to let it be by making the initial fellings still heavier, provided that the regeneration hoped for does not suffer thereby. The Coconino National Forest, Flagstaff, Arizona, is a case in point (paragraph 37). The idea of leaving enough for a second cut has been abandoned, as it has turned out to be practically impossible to leave enough for a second cut without making the present fellings unprofitable.

Climate.—is not so good as in North America. The possibility of having to stop skidding altogether for a couple of months in the worst parts of the monsoon period (because of excessive rain) and in the hot, weather (because of want of water) may have to be faced.

Labour and Staff.—Labour may be cheap and plentiful in India, but it is of poorer quality. For casual labour (roadwork, woodcutting, etc.) against say, Rs. 6 to 9 in the States before the War, the rate in India was only 12 as. to Re. 1, but an American workman does as much as half a dozen coolies. The contrast is likely to be still greater for some time in the matter of handling wire ropes. They are nasty things to touch with bare hands : skidder men know this well enough and wear leather gloves all day long. Until Indians get used to doing the same they will handle wire ropes very gingerly.

The supervising staff (Manager and Foreman) will cost more than in the States or Canada.

Taking into consideration all that is known at present, it is believed that a fairly good field for extensive railway skidding does exist in India ; the writer therefore suggests that matters be put to a practical test by starting operations in, say two localities, as soon as the necessary staff and machinery can be obtained. Neither the one nor the other is immediately available, and, of the two, the machinery is likely to take longer to procure. Moreover, prices are likely to go up rather than down for some time to come. Orders should therefore be placed without longer delay than is necessary to call for tenders.

It may be held that further advice should first be taken. In a separate report the writer indicates how expert opinion could be obtained, at a price, within a reasonable time.

Choice of skidding system and appliances.

54. Assuming for the sake of argument that the suggested experiments will be taken in hand—with or without the extra advice—the appliances likely to be required may be indicated.

The choice of system is between the Overhead, High Lead and Ground methods, and in the case of the second and third, between animal and mechanical outhauling.

In respect of the latter decision is comparatively easy, for animal outhauling may be ruled out as having little or no chance in India. Undergrowth is generally too dense, there are no draught horses and mules may not be easy to obtain. Oxen and buffaloes would be far too slow.

Assuming that mechanical outhauling is adopted, the difference in cost between overhead and other types of skidding is not so very great. The cost of the main cable and the carrier is about all it would come to. The question of first cost need not therefore be taken very much into account in making the choice.

On its own merits, as a method of logging, the writer believes that Overhead skidding has a wider application to varying local conditions, and is more likely to be generally suitable in India than either High Lead or Ground skidding. To give an experiment in India the best chance of success it should be principally Overhead.

In support of this view it may be remarked that overhead logging is believed to be even now as much in vogue in the States as the other two systems put together, and the use of it is thought to be extending at their expense. On the Pacific Coast High Lead logging is more practised, *but the big Douglas Fir forests there are not the best place in which to form an opinion about working in India*, as they are so totally unlike any forests in India outside the higher Himalayas.

It should, however, be realized that more than a single machine will be required to carry out an experiment anywhere on *an adequate scale*. This conclusion is reached from consideration of the other end of the operations, *viz.*, *the sawmill*. It must not be too small and it ought to be equipped with up-to-date machinery.

In Vol. II of this report reasons are given for making the statement that the minimum size for an experimental mill should be 100 tons of logs a day, and better still 150 tons. The smaller figure of the two—not the larger one—means plenty of work for two skidders without any margin. There should, therefore, be three machines, for which the following are recommended :—

(1) A Lidgerwood Overhead Tree Spar skidding outfit.

(2) A Lidgerwood skidder of the same design, to be used at first for Ground or High Lead work.

(3) A Ground skidder of any make, and preferably with a Boom.

Total six machines for two operations.

For (3), the two Washington Iron Works skidders now in Burma might suffice.

For (2), Lidgerwood slack-pulling machines are to be preferred so that they may afterwards be used for overhead work if desired, and also in case of a serious breakdown in No. (1).

N. B.—These suggestions are subject to confirmation after the localities for operation are chosen and local conditions known. It may, for example be possible to dispense with No. (3), if oxen or buffaloes are available for working outlying areas which may be beyond the reach of the overhead skidders.

55. Although the writer has formed the opinion that overhead skidding holds first place to-day in North America, and that most of the other power skidding could be equally well done by it, yet it is only right to mention that a good many lumbermen could doubtless be found to question the correctness of the second remark. Every lumberman the writer came across appeared to be quite satisfied that his own method of logging was the one best suited to his local conditions. To this view the answer is that all the methods of skidding and all the makes of machines

have so much in common, that a first class man could make a good show with any one of them anywhere. No instance can be recalled of change being made from one manufacturer's machinery to another's. This may be partly a matter of expense, but it also speaks well for the excellence of all the standard makes of logging machinery.

Skidders for teak logging.

56. The writer asked the five principal makers whether they could put up designs for a small gasoline machine for use in Teak logging in Burma. The machine would have to be small, as far greater portability by road would be necessary than that possessed by the heavy machines now in use in the States; and petrol would be preferable to steam because of shortage of water.

The case was put to manufacturers as follows. The hauling of logs from stump to the floating point on streams is generally divisible into two stages: *First*, from stump to dragging path; and *second*, along the dragging path to the floating point.

In the first stage the elephant can hold his own, but in the second stage engine hauling may prove to be the more economical. It depends on (1) the number of logs to be hauled along one and the same dragging path (or "Skidway" as it would be called in America), (2) the distance to the next path, and (3) the kind of country to be traversed to get there.

There are numerous instances in Burma of a hundred or more logs being hauled along the same dragging path, and as such a number would keep a small machine fully occupied for 3 or 4 days, or even a whole week, point number (1) may be looked upon as met.

The real difficulty lies in the transport of the machine to the next scene of operations. Self-hauling on ordinary timber skids would be too hopelessly slow to be worth thinking about. It is therefore up to manufacturers to say whether it is possible to design a machine, of the requisite power and range, which could be taken to pieces for transport on skids by elephant.

The above is the way in which the case was put forward some months ago. In the interval "Baby Tanks" have made their appearance, and it is quite within the bounds of probability that in them lies the solution of the problem of finding a machine much superior to the elephant in power, but only very little inferior to him in portability.

57. *Manufacturers of Logging Machinery—*

The United States.

The Lidgerwood Manufacturing Company, New York.
The Clyde Iron Works, Company, Duluth, Minnesota.
The Washington Iron Works Company, Seattle, Washington.
The Willamette Iron Works Company, Portland, Oregon.
The Puget Sound Iron and Steel Works Company, Tacoma, Washington.
The Smith and Watson Iron Works Company, Portland, Oregon.
Stewart Brothers and Company, Portland, Oregon, } (pulley blocks and ropes
F. B. Mallory Company, Portland, Oregon. } etc. only).

The American Hoist and Derrick Company, St. Paul, Minnesota. ⎫ (loaders
The Marion Steam Shovel Company, Marion, Ohio. ⎭ only).

British Columbia.

The Empire Manufacturing Company, Vancouver, B. C.

The Vancouver Engineering Works Company, Vancouver, B. C.

There are other manufacturers in the Eastern and Southern States and in Eastern Canada, but they are not so well known and, even in these parts of the continent, the greater part of the logging mahinery in use is of Lidgerwood or Clyde make

The premier firm is undoubteldly the Lidgerwood Manufacturing Company, who not only do business all over the States and Canada, but are well known all over the world. Clyde logging machinery is almost as well known. The Pacific Coast firms mentioned only do business on that side of the continent.

As already remarked one thing all the firms named above can, with confidence, be said to have in common is the reputation for putting good materials and good workmanship into the machinery they turn out. It can be relied upon to stand up against any amount of hard work and rough usage. All the firms publish very good catalogues. Anyone interested in steam logging is recommended to study the photographs and drawings with which they are copiously illustrated, especially Lidgerwoods and Clyde.

It is generally admitted that *wire ropes* of British manufacture are superior to all others.

It is to be noted that, in addition to patent rights in particular types of machines, the various methods of rigging up the ropes for skidding are also covered by patents. For example, although the firms on the Pacific Coast have done most of the development of the High Lead system, the idea originated with, and was patented by, Lidgerwoods. This firm has chosen to let the matter slide, and rests content with the exercise of its patent rights in details of machines, such as interlocking drums, slack-pulling etc.

CHAPTER IV.

LOADING AND UNLOADING OF LOGS ON RAIL.

58. The lifting of logs a few feet into the air and placing them on railway cars may seem to be such a simple operation, compared with skidding them on the ground or in the air for half a mile or more, that it may appear unnecessary to devote a whole chapter of this report to the subject.

The simplicity of loading is apparent rather than real. In fact it is no exaggeration to say that good loading is half the battle in a logging operation. Even if the parts of this report dealing with steam skidding are passed by, owing to want of belief in the possibility of installing such appliances in India, it is hoped that the notes on Western methods of loading will meet with a better fate.

The subject is already one of importance in India. The case of one of the first European firms in Burma to take up the extraction of Pyingado by rail may be quoted as an example. During the three years of the writer's personal contact with the firm, one of the chief stumbling blocks to the success of the logging operations was the want of a really good method of loading logs on the little 2 feet gauge cars. There can be no doubt that it would have paid the firm hand over fist to have studied the problem in America before starting operations and landing themselves in difficulties.

There is a good chapter on Loading in "Logging," of which free use has been made in the following notes.

Combined *v* separate skidding and loading.

59. Opinions differ as to whether loading should be done along with, or separately from, skidding. A combined machine may have only one boiler, but it has two independent sets of engines with a separate crew of driver and attendants to each. Either operation can go on without the other provided that there are any logs left to handle.

In the Eastern and Southern States both methods are practised. For example in the Appalachians, at Townsend, Tenn., the writer saw the operations separate; whilst under similar conditions not far off, at Cresmont, Kentucky (not visited) the operations are combined.

In the swampy Mississippi Bottom forests at Sardis and Charleston the operations are separate; whilst in the Cypress swamps at Lutcher and Donner they were seen to be combined.

No examples of separate loading were seen either in the big Redwood or Douglas Fir forests on the Pacific Coast, or in the more thinly stocked Yellow Pine forests in California or Idaho.

Combined operations are decidedly indicated in very heavy stands, as otherwise the pile of logs at the track would become so large as to reduce the speed of loading. They are also economical in rails, as spurs can be taken up more quickly.

On the other hand, combined operations depend for their success on the efficient co-operation of the railway. The daily supply of empty cars must be forthcoming or else both skidding and loading will be hung up. Moreover, for two or three months of the year, felling and skidding may be practically out of the question, owing to snow or floods, although it may still be possible to keep the railway track open and to do loading. If this is done there is no necessity to accumulate such a large stock of logs at the mill, in order that the latter may be kept running all the year round.

It is quite possible, however, that there may be differences of opinion on the subject in India, as there are in the States. The writer is inclined to think that separate skidding and loading should be tried first, because it will take time to train men to work efficiently in the different branches of the operations. It will be safer, at first, to keep the various branches as independent as possible of each other, *i.e.*, felling and logging in advance of loading, and railing in advance of the mill.

Method of attachment of ropes to logs.

60. There are a number of different ways in which skidding and loading ropes are attached to logs, namely, single or double ropes, with hooks, tongs or slings.

For *Skidding*, either tongs or slings and "Choker" hooks are used, the latter being the commonest method, and, indeed, the only one used in overhead skidding. It is hardly necessary to remark that the hooking on is always done as near as possible to one end, never in the middle of a log.

Tongs are common in operations where the logs do not vary much in diameter and are not very large.

The use of tongs in conjunction with cones has already been referred to (paragraph 45).

For pull-boat skidding in the Cypress swamps a special method is used. Holes are bored in pairs near one end of each log. In these holes iron plugs ("puppies") are inserted with a short length of chain attached.

For Loading, the following methods of attachment are in use:—

(1) Spike hooks in both ends of the log, attached to short lines joined together, and passing through the loading block as a single line.

(2) A pair of tongs, or a sling, at the middle of the log.

(3) Two pairs of tongs, or two slings, one on either side of the middle of the log, and *attached to short lines* joined together *before* passing through the loading block as a single line.

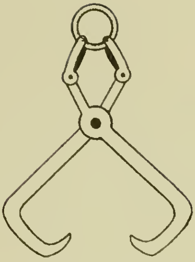
(4) Two pairs of tongs, or two slings, on either side of the middle of the log, *attached to two long lines* passing through two loading blocks, and then joined together as a single line to the engine.

(5) Same as (4) except that the lines remain separate altogether and pass to two separate drums on the engine (Duplex Loaders).

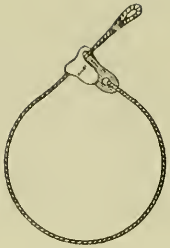
End hooks are used a great deal for logs of fairly uniform length, and tongs are popular for logs of fairly uniform diameter.

Spike hooks have lengths of hemp rope attached to them. Two men standing on, or near, the pile of logs being loaded handle these ropes, steadying each log as it is being deposited on the car and pulling the hooks back for the next one.

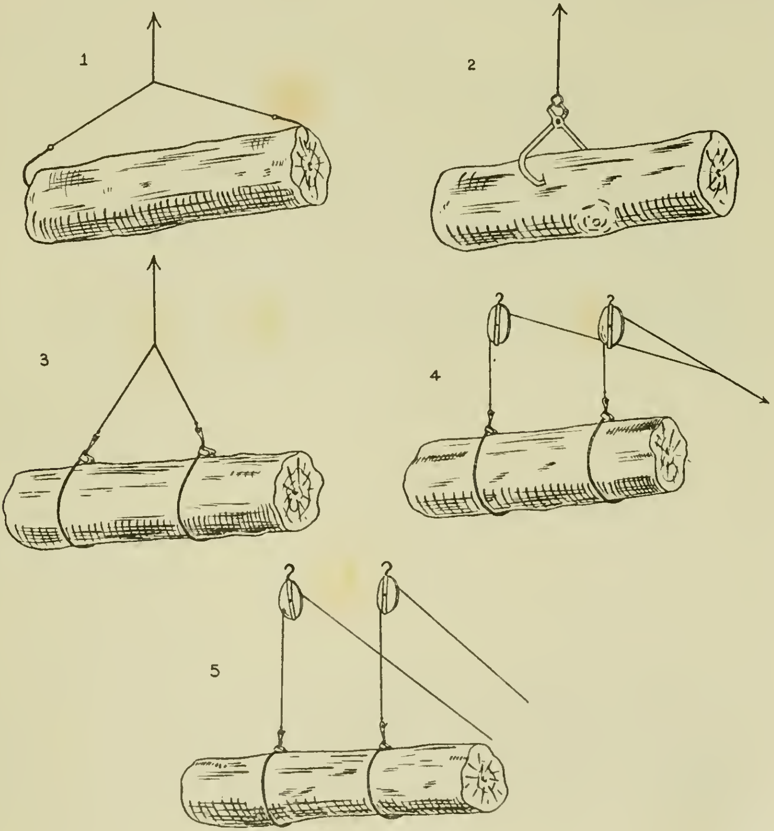
PLATE XXXV.



Skidding Tongs



Choker Hook & Sling



METHODS OF ATTACHMENT OF LOGS FOR LOADING. (para 60)

Designs of loading machines.

61. Skidding machines can be used for loading, but it would not be economical to employ them permanently for the purpose because full use would not be made of their drum capacity. For loading, only one or two hundred feet of medium size rope (½″ or ¾″) is required, whereas the drums on a skidding machine can carry several thousand feet of heavy rope (¾″ to 1¼″).

There are plenty of patterns to choose from. Not only do all makers of logging machinery turn out loaders, but other firms do so as well. In fact, as noted later on in paragraph 68, the favourite Boom Loader is made by a firm which does not go in for the manufacture of skidding machinery at all.

Loading machines fall into two classes :—

(*a*) *Boom machines.*—in which the loading rope is elevated by being passed through a block on the end of a jib, or boom, attached to the framework of the machine itself.

(These machines are described in paragraph 68).

(*b*) *Machines without Booms*—the block for elevating the rope being attached to an outside support, gin pole, guy line, tree spar, etc.

All makers turn out machines of this class resembling skidders with small drums, and also like them in having non-reversible engines.

The " Duplex " Loader made by the Washington Iron Works Company and by the Empire Manufacturing Company, deserves special notice. It is a two-line machine, the line drums being driven by independent and reversible engines. By operating with two separate lines either end of a log can be raised or lowered at will, and by having reversible engines the speed of playing out the ropes can be increased. Whereas the ordinary type of single line machine could not keep pace with improved methods of High Lead skidding, it has been found that the " Duplex " loader can do so.

62. The following methods of loading are practiced :—

(1) Parbuckling.

(2) Gin pole.

(3) Guy-line and Overhead.

(4) Derrick.

(5) Tree Spar Boom.

(6) Boom Machines.

  (*a*) Fixed Boom.

  (*b*) Swinging Boom.

  (*c*) Revolving Machine.

All of them can be operated in combination with, or separate from, skidding. Even when run simultaneously it is a matter of choice whether both engines are on one common mount and fed from one boiler, or whether the two machines are quite independent of each other and on separate mounts. The various appliances differ of course in the cost of operating. It is a sound rule to economize on boilers by having as few of them as possible.

Parbuckling.

63. The simplest form of parbuckling is the animal type, which is so well known that no description is necessary. It is in general use on logging operations conducted without the use of steam skidders at all. There is one detail that is worth noting. Even for road transport, and obviously so for railways wherever possible, logs are collected for loading, instead of being picked up anywhere, and at the loading place preparation for loading is made before the logs are hauled in from the forest. Pairs of long and straight logs, or stout poles, are laid at right angles to the railway or road track, forming a "skidway". As the logs come in they are dragged across the ends of these skids and rolled forward. A high pile may thus be built up with the logs lying parallel to the track. This methodical arrangement of logs, at temporary sidings and depôts, stands out in marked contrast to the promiscuous way in which logs are so often dumped down and left in India, without any thought for the loading which is bound to take place sometime or other.

Parbuckling by steam power is common on the Pacific Coast. The writer saw a good example at Bridal Veil, Oregon. Two "donkeys" are used: one ground skids the logs up to a distance of 1,500 feet on to a skidway, and the other loads them. The logs are big, so that the skidway is a substantial affair of heavy logs banked up almost to the level of the car bunks.

Opposite to the skidway, or "landing", and on the far side of the track, a gin-pole is guyed on the slant, so that a block near the top hangs midway between the rails. The loading rope runs through this block. To load a log the rope is passed over it and then brought back and hooked to a short bit of line fastened to the gin-pole, and lying on the top of the car. Sometimes double lines are used.

A drawback to this method of loading is that a certain amount of time is often lost in rolling one log over another, in order to get at the best one to make the load balance or pack properly. This does not matter so much with steam engines as there is generally plenty of power to spare.

Gin pole.

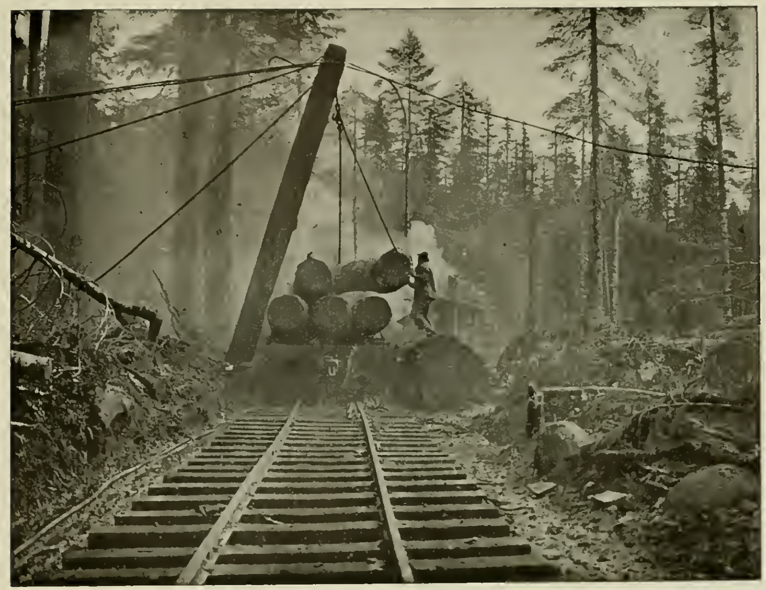
64. The Gin pole has already been mentioned in connection with parbuckling. The term "Gin-pole" is applied to any timber post carrying a pulley wheel and guyed in a slanting position with ropes. It can obviously be used for lifting logs as easily as for rolling them. The longer the pole, the simpler it becomes to swing logs easily without bumping hard against the sides of the car, and to move the logs by hand into exactly the best position on the car.

At Elk, Calif. for loading heavy Redwood logs a pair of gin poles, 80 feet long and tied at the top, is used in conjunction with Ground skidding.

It is only a variation of the method to have two gin poles and two separate lines and drums.

Guy line loading.

65. If the loading pulley block is supported on any form of aerial cable the method is known as Guy Line Loading. It gets its name from the fact that use is generally made of one or more of the guy lines of a skidding outfit. It is the commonest method of loading in conjunction with skidding, where operators do not

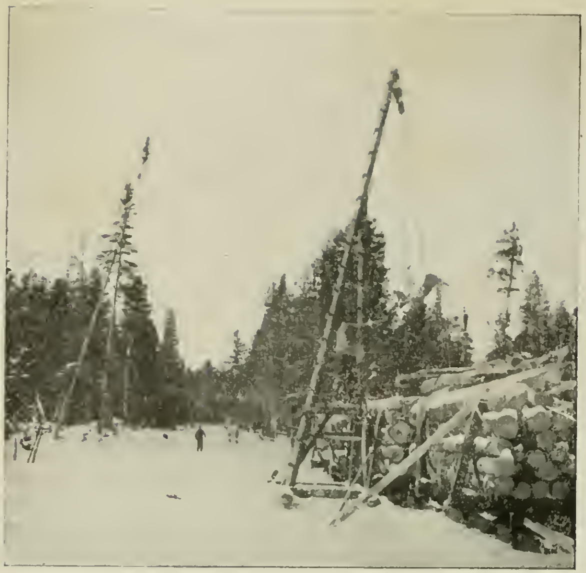


(1). Parbuckling by Steam Power ; 3 feet track.—Bridal Veil, Oregon.

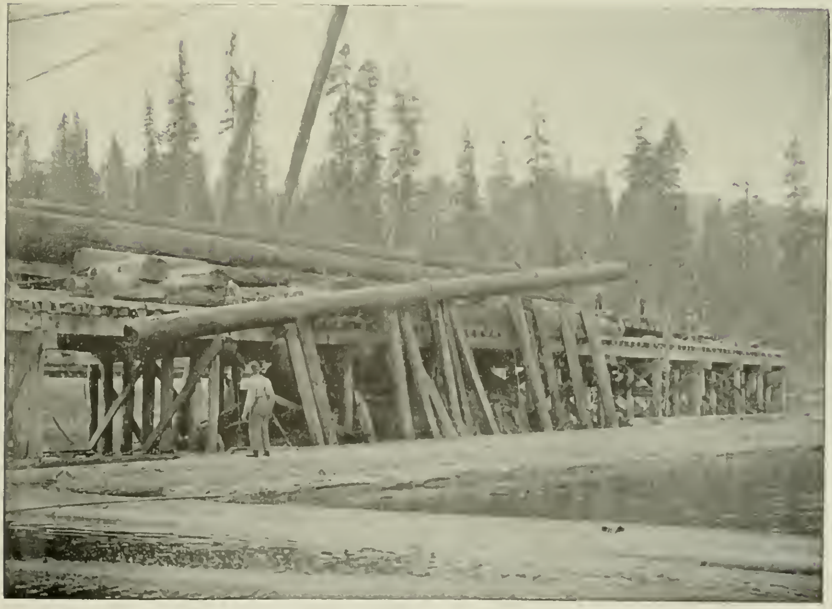
(para. 63).

(2). Two-legged Gin Pole, 80 feet long.—Elk, California.

(para 64).



(1). PORTABLE GIN POLE ON SNOW SLED
Sleigh on right being loaded from pile of logs (not shown) ;
rope being pulled by horse.—River Marnie, Quebec.



(2). Gin Pole Loading from water.—Lake Cowichan, B. C.

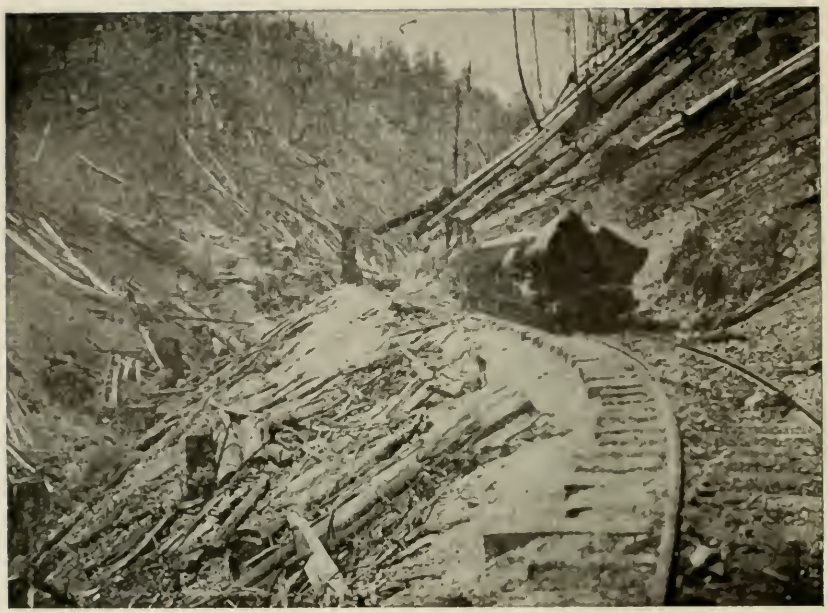
(para. 64).

Plate XXXVIII.

(1). Single Guy Line Loading:—New Bern, N. C.

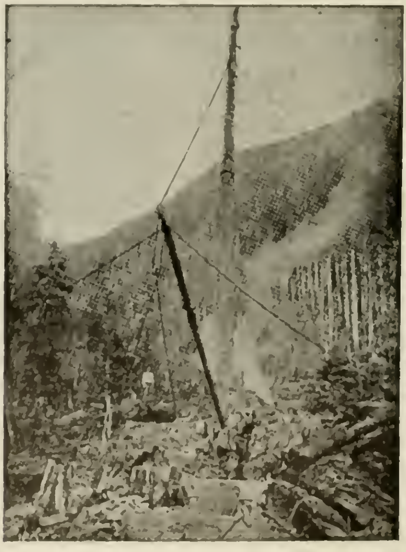
(2). Double Guy Line Loading in combination with High Lead Skidding in Douglas Fir Forest. Myrtle Point, B. C.

(para 65).



(1). Sky Line Skidding and loading in a single operation, (see also plate XXXII); one car fully loaded; log suspended over the track (3 ft.) waiting for another car to be brought forward;—Elk, California.

(para 65).



(2). Tree Spar Boom Loader.
(By permission of Messrs. The Lidgerwood Manufacturing Co.)

(para. 67).

care to go in for the more expensive types of combined machines equipped with booms for loading.

A spar tree near the track is required. If loading is combined with Overhead, or High Lead skidding, the spar tree or moveable spar is there, ready for the loading crew to make use of.

It is usually strengthened by four guy lines, two at least of which are bound to be fastened to trees or stumps on the far side of the track Up one of these two guy lines a carrier is drawn until it hangs midway between the rails; it is then clamped in position.

The loading rope passes through a pulley block hanging from a carrier. The pulley block should not be less than 20 feet from the ground and double this height or more would be better.

The loading need not be confined to logs close to the track. It is only limited by the capacity of the drum and the strength of the hook-tenders. The line can easily be pulled out from one to two hundred feet.

There are variations in method, as may be gathered from the list of the different ways of attaching hooks, tongs, or slings given in paragaph 61. On the Pacific Coast the favourite plan, in conjunction with High Lead skidding, is to use two loading lines passing through blocks attached to carriers on two guy lines. These two lines may then be united (No. 4) and pass as a single line to the engine (ordinary type); or they may remain separate (No. 5) being wound on two independent drums (Duplex Loaders *vide* paragraph 61).

The guy line method of loading is worth special study because it has such a wide range of application, and does not require anything elaborate or expensive in the way of outfit in the woods. If one fair sized tree is available near the track a substitute for the skidder guy line can be rigged up. If there are two trees, one on each side of the track, it is all the easier, and a short overhead cable can be installed. It does not matter if the cable is skew to the railway. A 2-drum engine on skids, or better still on a car, is sufficient to supply the power. A winch head (gypsy) on one shaft comes in handy for rigging up the cable.

Such a method of loading would be a good one, for example, in an operation where logs had been dragged from a compartment by animals and dumped down anywhere within two hundred feet of the railway, in bunches of not less than a hundred or so, according to size. The engine, if mounted on a car, could be side-tracked as explained in paragraph 32.

Derricks.

66. Derricks are mentioned for the sake of completeness, although they are not used outside yards and permanent depôts. They are either of the Guy Line or Stiff Leg type. They are operated either by hand or by power.

Tree spar boom.

67. The ordinary type of Tree Spar Boom loader is simply a jib or boom derrick with a tree as standard. The boom can be swung like a derrick either by means of a Bull wheel at the base, or by a pair of lines from drums on the engine. These lines pass through two pairs of blocks, one at the base and the other

high up on the boom and then fastened to convenient stumps on either side, or better still on other guy lines.

A special type is known as the *McClean Boom Loader*, an example of which the writer saw at Wind River, Wash. It differs from the ordinary type in that the boom is suspended horizontally. There are two loading ropes joined together and operated by one drum. The ropes pass through blocks suspended from brackets on the boom. These iron brackets stand out at right angles and have a number of holes in them, permitting of adjustment in order to get the blocks to come over the middle of the railway track simultaneously. Only one drum is used for swinging the boom. The line from this drum passes through a block clamped to a guy line, and its end is fastened to the end of the boom. By means of this rope the boom can be pulled away from the track. When this rope is released the boom automatically swings back to the track by the action of a counterpoise running up and down a guy line and connected to the boom by a line.

It is claimed for this method of loading that it gives better results than the guy line method for heavy logs, owing to there being so much less spring in the loading ropes. This remark is equally true of all the boom types.

Boom machines.

68. By the term "machine," as used in this and the following paragraphs, is meant a mechanical device in which all the parts of the apparatus are mounted on a single framework, *i.e.*, no parts stand independently on the ground or attached to trees, etc.

There are three types :—

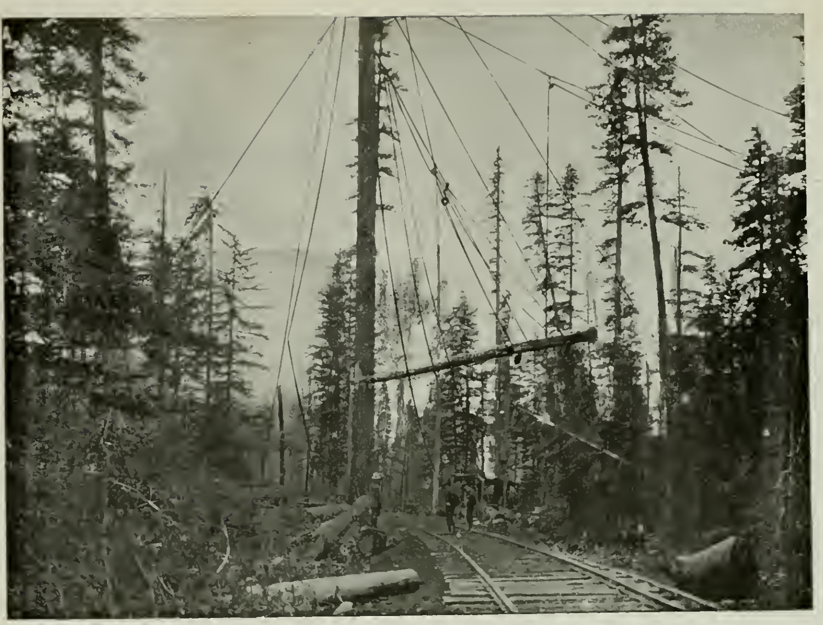
(*a*) *Fixed Boom on a stationary platform.*—This operates in practically the same way as the gin pole type. A Ground skidder with an A frame boom mounted on its timber skids is one makeshift form sometimes to be met with.

At Madawaska, Ontario, the writer saw a fixed boom loader at work on a double track siding. The machine mounted on a car stood on one track, with its boom, reaching over the car, being loaded and standing on the other track alongside.

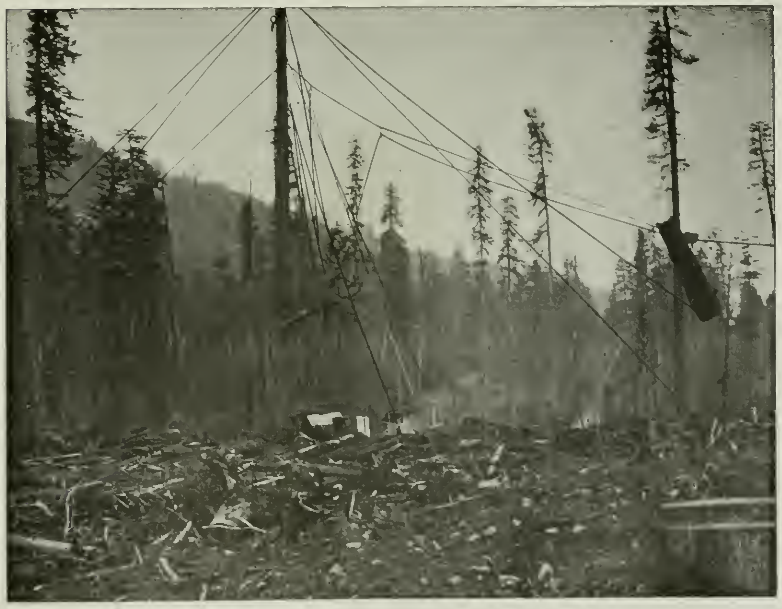
(*b*) *Swinging Boom on stationary platform.*—This type is a common one in combined skidders and loaders. Several makes are good. The boom swings in a vertical plane, and its movement is controlled by the engine.

The *Surry Parker Loader.*—(made by the Surry Parker Company Pinetown, N. C.) This machine is of an inexpensive type and similar to the timber frame Lidgerwood machine, just described, except in respect to the boom. The upper support of the latter overhangs the lower one, so that, when left free, the boom tends to come to rest over the middle of the track. By means of a hand rope the boom is pulled round. As soon as the log has been raised high enough the hand rope is released, and the boom swings back over the car being loaded.

This machine is a good deal used in the Southern States.

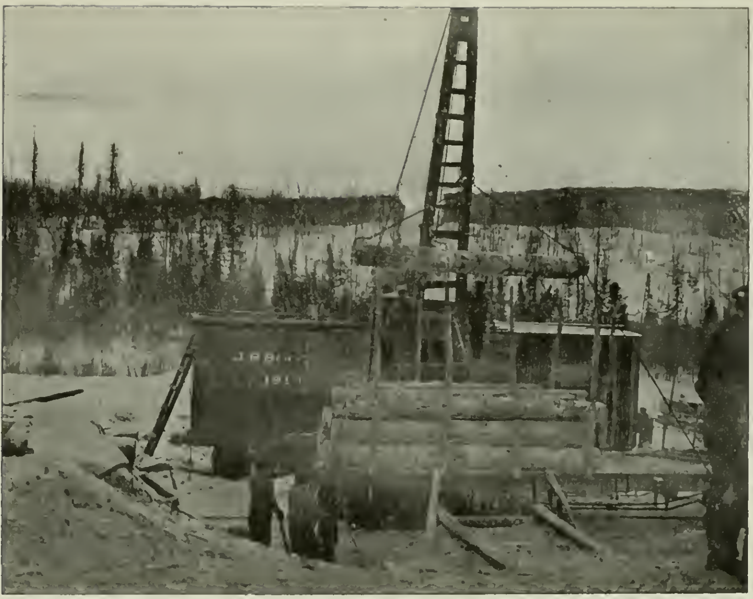


(1). McClean Tree Spar Boom Loader ;—Wind River, Washington.

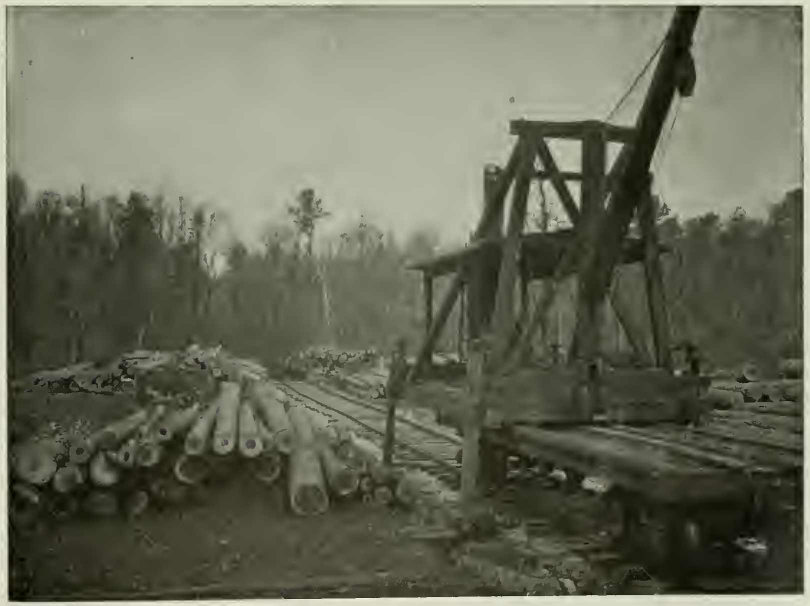


(2). Same as above ; counterpoise log running on Guy Line shown to the left.
Wind River, Washington.

(para. 67).

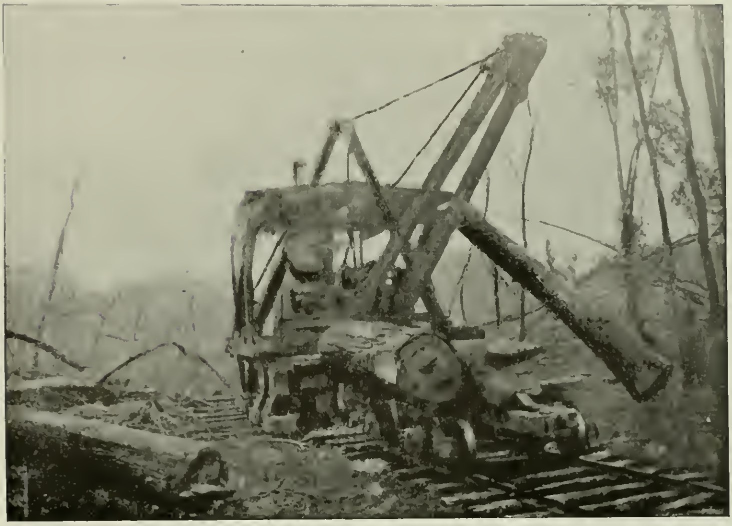


(1). Fixed Boom machine mounted on car, loading pulp wood ; double track;— Madawaska, Ontario.

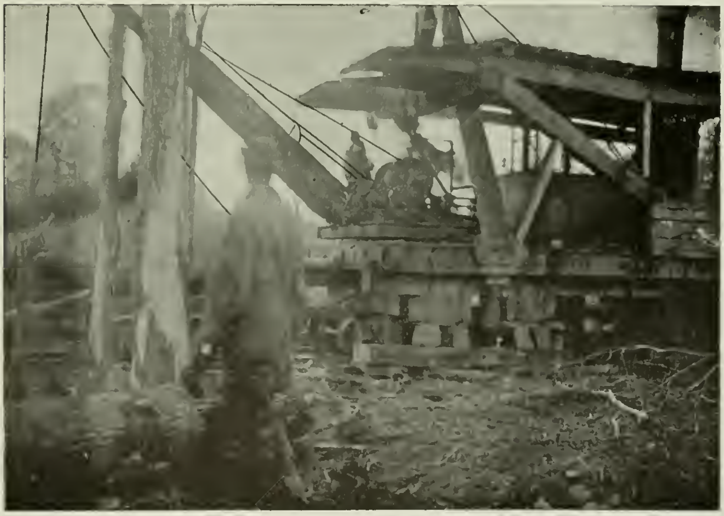


(2). Surry Parker Loader, empty car passing through :—New Bern, North Carolina.

(para 68).



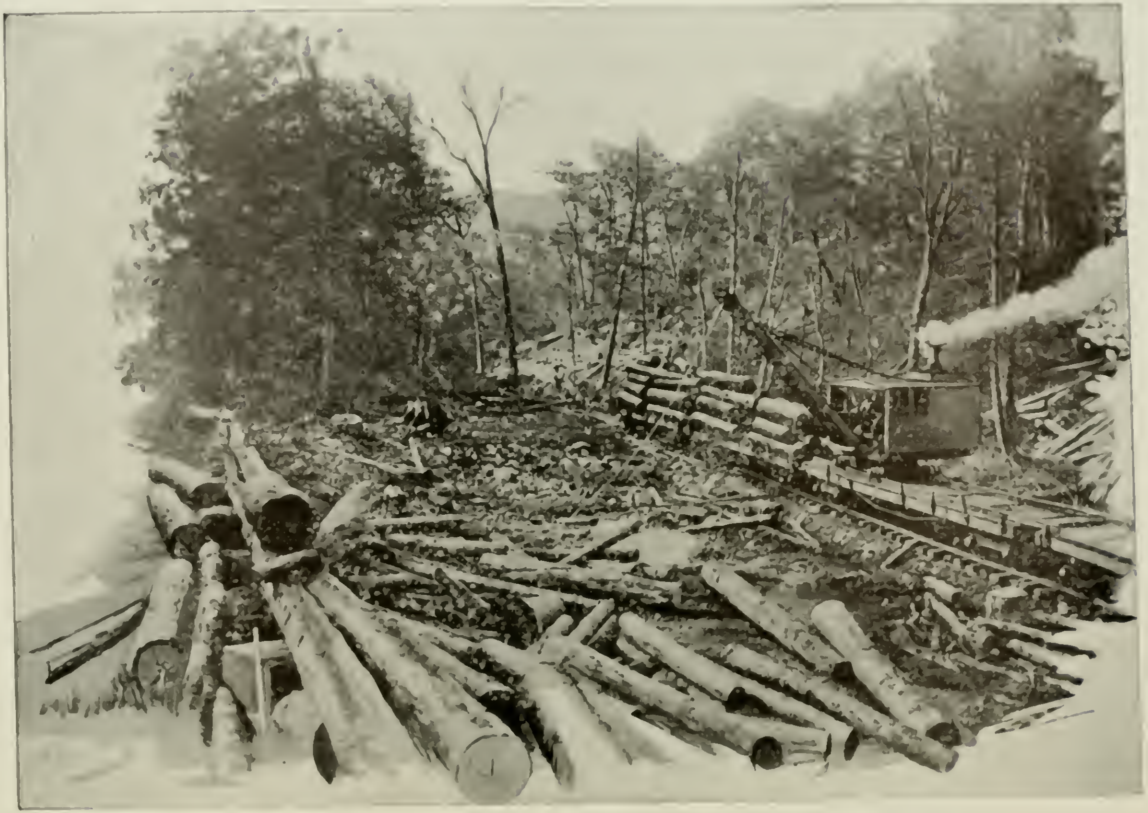
(1). Old Type of Lidgerwood Swinging Boom Loader mounted on a timber platform jacked up over the railway track.—Sardis, Mississippi.



(2). Same as above, showing near view of wood blocks supporting the platform :—Sardis, Mississippi.

(para 68).

Plate XLIII.



"AMERICAN" LOG LOADER.

(By permission of Messrs. the American Hoist & Derrick Co.)

(para 68).

(c) *Revolving machines.*—The whole machine can be swung round by means of gearing. Both Lidgerwoods and The Clyde have machines of this type on their combined skidders and loaders.

The machines which are in most general use by operators, all over the country, who keep skidding and loading separate are:—

(1) The "American" Loader by The American Hoist and Derrick Company, St. Paul, Minnesota.

(2) The "Rapid" Loader by The Clyde Iron Works Company, Duluth, Minnesota.

(3) The "Barnhart" Loader by The Marion Steam Shovel Company, Marion, Ohio.

All of these machines certainly work fast and efficiently. The balance is so good that logs can be skidded up to a distance of 150 to 200 feet from the track, without much risk of overturning. In fact, from conversation with a driver on one of the machines, the writer gathered that accidents would be still rarer than they are if more care was taken not to open the throttle too wide, without waiting to see that the tongs had gripped properly. If they tear out, the machine gets a bad jerk backwards. Only once in nine months had the machine ("American") actually overturned in the case referred to, and then the engine was made to pull itself up again in a few minutes, and was none the worse for the upset.

A detail of design in loading machines which it is worth while to pay attention to is the structure of the boom. The "American" and Lidgerwood machines (and possibly other makes) have a lattice girder type of boom giving a broad surface for the butt end of a log to rest against, without much risk of slipping off. When loading is in progress no particular care is taken to put on the tongs or sling so that logs may balance evenly. It does not matter much if one end does stick up in the air when a log is raised off the ground. The log is swung round until the upper end comes under the boom, and then the loading rope is wound up still further. This jams the upper end of the log against the boom and elevates the other end. With the logs in this horizontal position, the boom is swung round until the log is over the car being loaded. Slackening the rope causes the outer end of the log to drop first, and it can be guided into position by hand.

Mounting of loading machines.

69. In the case of Parbuckling, Gin Pole, Guy Line and Tree Spar Boom loading the machine can stand on any kind of mount, and is usually placed off the railway track. Boom machines are obviously intended to work on the track. The various types of mounting in use with them resolve themselves into devices for getting empty cars past the machine without interfering with it (*vide* paragraph 32).

Two plans are in use. The first one has already been described in discussing the mounting of skidders, and consists in devices for jacking up the platform so that empty cars can pass below.

In the other plan the loading machine itself moves and shifts back on to the next car.

At Tyson Creek, Idaho, the writer saw a boom skidder on timber skids hauling itself from one car to another whilst engaged on loading operations, but this can only be recommended as a makeshift.

The "Rapid" Loader rests on iron skids with upturned ends, and can be moved forward, as its name implies, without much loss of time.

The unique feature of the "American" Loader is that it propels itself, by means of gearing, on rails on the car tops. In some logging operations all the stock of flat cars have a pair of rails permanently spiked down to the platform. The loader carries a couple of short rails to bridge across the gap between cars.

In another pattern of the same machine this equipment of all the cars with rails is dispensed with. The loader is provided with two sets of rails on which to propel itself. They are not spiked to the cars at all. Standing on one set the machine can pick up the other one, swing round and drop it on the car behind. The wheel base of the machine is so long that bridge pieces between cars are not required.

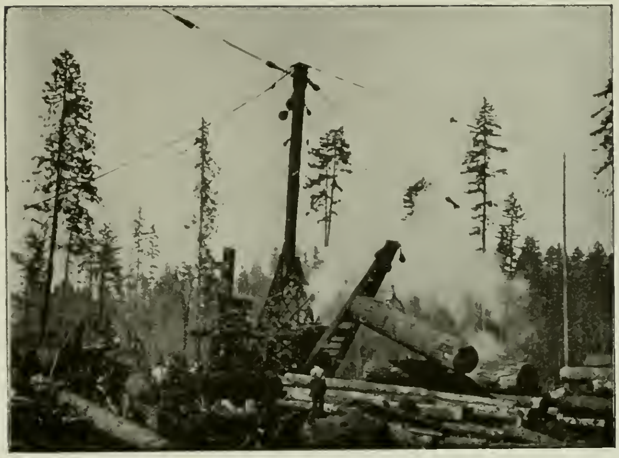
Unloading.

70. The commonest method of unloading cars is to super-elevate the outer rail. To keep the cars themselves from turning clean over, and also to get the logs to roll away from the track, a sloping timber slipway is generally constructed. Parbuckling by steam power is common.

For further details of unloading devices attention is invited to "Logging" page 332.

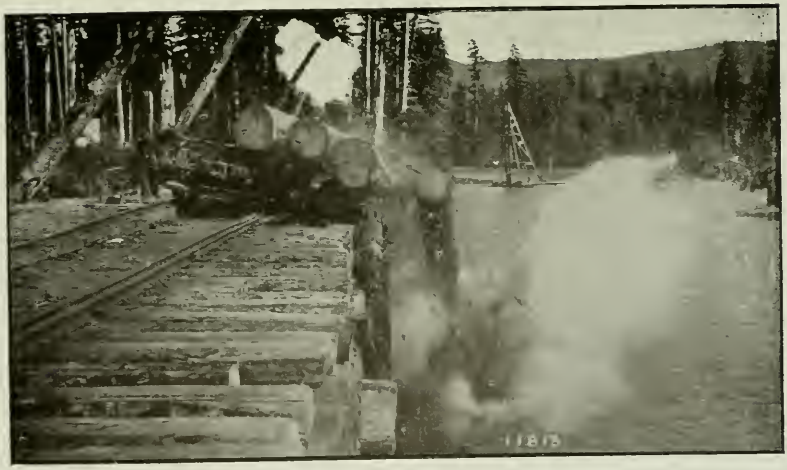
The question of storage of logs in the mill yard, or pond, is discussed in the chapter on Sawmills (*vide* Vol. II).

Plate XLIV.



(1) Lidgerwood latest type of Combined Skidder and Loader.
(see also plate XXVI); —Kapowsin, Washington.

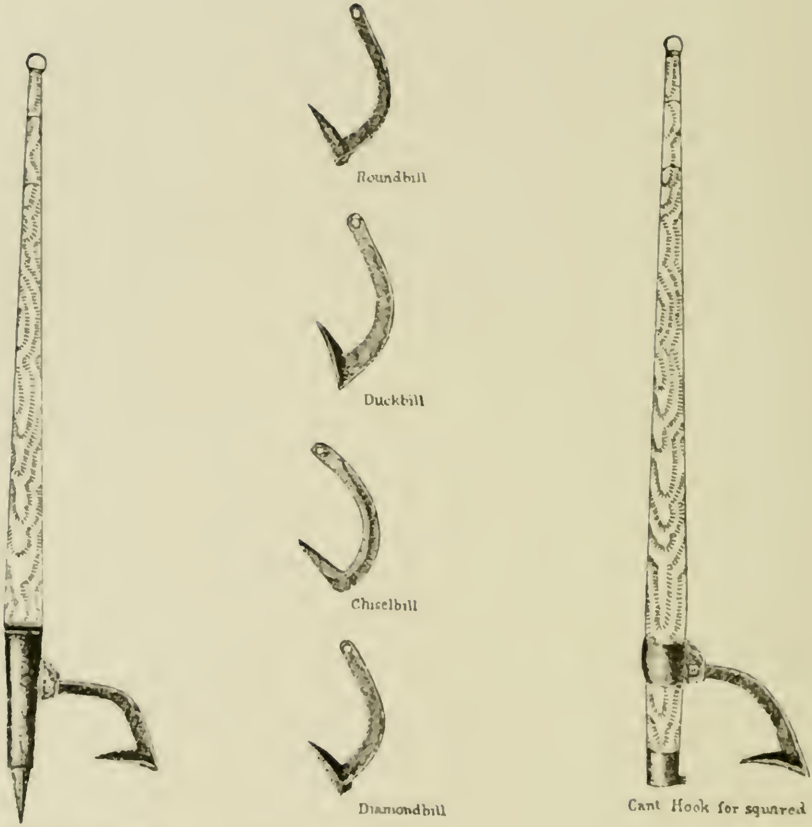
(para. 68).



(2) Dumping logs from cars into San Juan River, B. C.
(Dominion Forest Service Photo).

(para. 70).

PLATE XLV.



Peavey for round logs

Roundbill

Duckbill

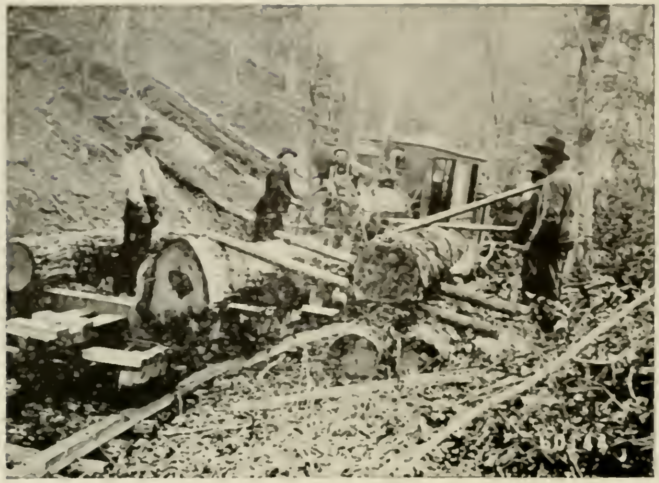
Chiselbill

Diamondbill

Cant Hook for squared timber

Common Types of Peavies and Cant-Hooks.

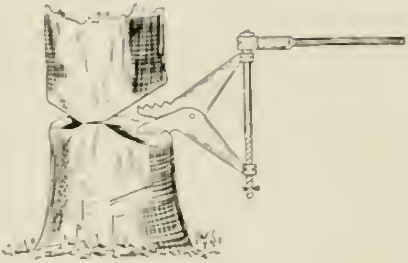
(para 71)



USE OF PEAVIES IN LOADING LOGS.

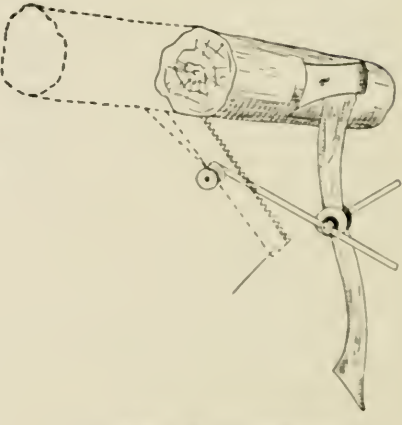
(1). Note the use of a locomotive on wood rails (3 ft. track)
(U. S. Forest Service Photo).

(para 71).



(3). Tree Faller

(para 73).



(2). Under cutter for cross cutting
logs from below.

(para 72).

CHAPTER V.

LOG MAKING, ANIMAL HAULAGE AND ROAD TRANSPORT.

The Peavy.

71. An indispensable part of a logger's equipment is the lever with which he handles logs. The tool is known as the "Peavy". There are several different forms, all having a general resemblance to each other. Peavies are to be found everywhere—in the woods, on carts, cars or rafts, at depôts, in yards and in mills. Nobody would think of trying to move a log without one, unless hard pressed. To a newcomer it is astonishing to see how easy it is to roll logs with them. It is equally easy to turn heavy baulks of timber.

It is hoped that early orders will be placed for a good supply of this useful tool, so that everybody handling timber in India may have an opportunity of becoming acquainted with it.

The well known Wegyi Depôt project in Burma (as originally planned) depended largely for successful operation on the rapid moving of heavy Teak logs along skidways raised a few feet from the ground. One of the causes of failure of the scheme was the fact that big logs never were moved quickly, even when shoved by as many coolies as could find standing room behind them. What a pity nobody thought of the peavey! Half a dozen coolies armed with them could have rolled the heaviest and ugliest log that ever rested on the skidways in half the time actually taken by 30 or 40 men.

Undercutters.

72. When a saw is likely to jam in cross-cutting, instead of wasting timber by chopping through with an axe, it is a common practice to saw through from below. The "Undercutter" is a useful little tool for supporting the saw. It consists of a small grooved wheel (on which the back of the saw rests) held in position by a bracket and spike, or simpler still, by being clamped to the handle of an axe driven into the log.

Tree Faller.

73. Supplementary to the proper making of the axe and saw cuts, the keeping of saws from jamming, and the throwing of trees are usually done with iron or wooden wedges. A few years ago a firm on the Pacific Coast brought out a patent "Tree Faller" shown diagrammatically in the accompanying sketch. It has not become popular, possibly owing to the weight of the outfit (166 lbs.) The idea seems to be a good one.

Gasoline Drag—saws.

74. Practically all the cross-cutting of logs in the forests (or "Bucking" as it is called) is done by hand. A very handy little machine, which is becoming increasingly popular in lumber camps where there is much cross-cutting of logs into firewood, is the *Gasoline Drag-saw*. There are several patterns on the market, all very much alike in general appearance. The writer saw only one of them in actual operation, *viz.*, the Drag-saw made by the Vaughan Iron Works Company, Portland, Oregon, and can recommend it.

Removing bark from logs.

75. Although it can hardly be said to be a common practice to bark or peel logs before railing, yet it is done locally. This is the case in the first operation visited, at Madawaska, Ontario. By peeling Balsam and Spruce pulpwood at the time of felling in May, from 16 to 17 cords can be loaded on a car in January, whereas, with the bark on, only 10 to 11 cords would make a full load. White Pine is not peeled, however, owing to the resultant discoloration of the wood.

It would be worth while trying experiments in India. To be able appreciably to reduce the weight to be railed would be a consideration, if it could be done without subsequent damage to the timber.

Tongs for dragging logs.

76. It invariably raised a laugh when the writer told lumbermen that it is the universal practice in Burma to cut holes ("napa") in the ends of logs for dragging purposes. Tongs are practically always used for animal haulage and also, to some extent, in steam skidding. The writer would recommend encouragement of the use of them in India where the logs to be dragged do not vary too much in diameter. Well driven in tongs do not fall off every time the hauling animal pulls up. They need not be very heavy or clumsy if made of good steel.

Team hauling.

77. It must not be supposed that all the hauling of logs is done by steam skidders in all operations where the latter are used. In the Eastern and Southern States steam skidding is very largely supplemented by team hauling, except where conditions are unfavourable for the latter—such as dense underbrush or swampy ground. In hilly tracts, with a poor "stand" per acre, it is often cheaper to log the upper parts of the slopes by animals, than to go in for the extra amount of railway construction necessary to reach all the logs by steam skidders, *vide* the operations at Townsend, Tenn. The only point it is desired to emphasize about animal hauling is that it is found to pay well to help the teams by going to the trouble and expense of making good dragging paths, and improving the surface by placing cross timbers at short intervals. It is true that the same thing is done in Burma, but it is believed to be to a less extent, especially in respect of the alignment of drag paths on steady and good gradients.

Sleds and log slides.

78. There is a good deal of information in "Logging" on the subject of sleds and log slides, some of which may be of use in India.

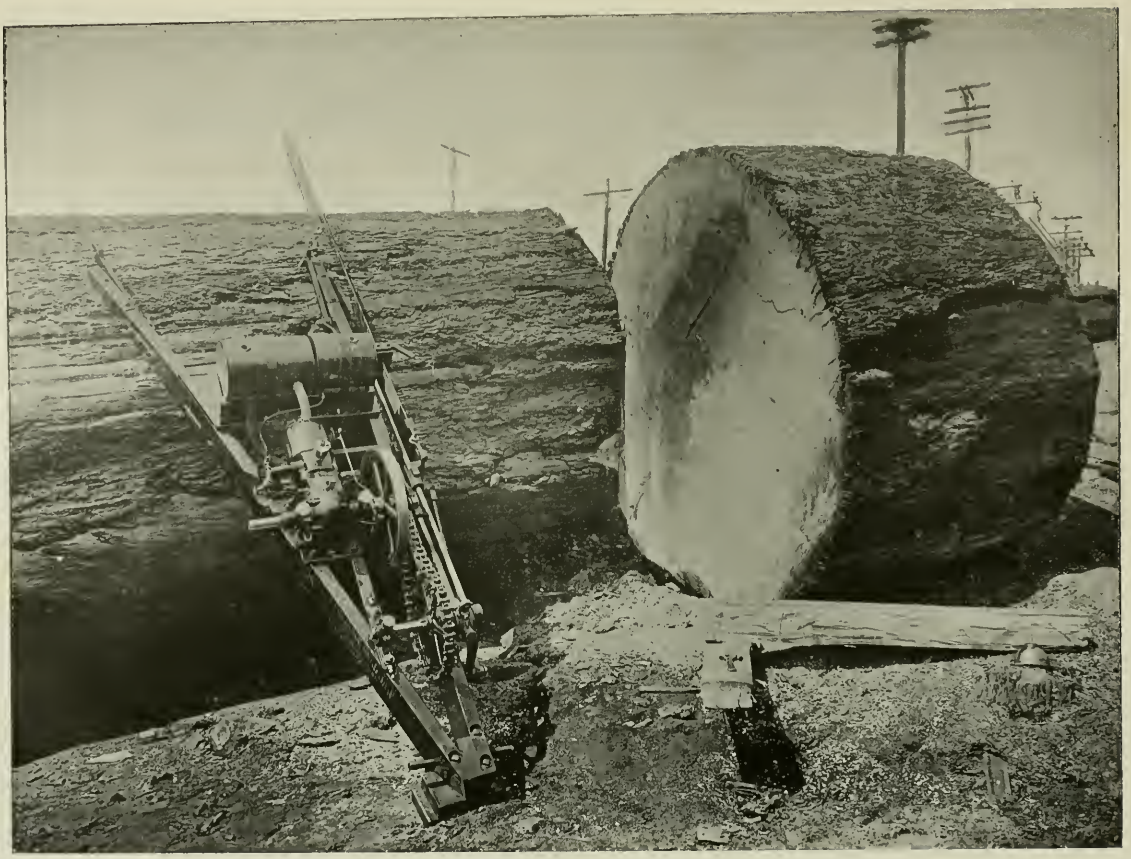
Big Wheels.

79. On fairly hard ground and easy slopes and in open forest, Big Wheels 10 to 12 feet in diameter are used to a considerable extent. The load is suspended by a chain, with both ends fastened to the axle. Turning the axle round tightens the chain and raises the load off the ground.

There are two common types of the Big Wheels, which differ in respect to the method of turning the axle.

In the *Slip Tongue type* the shaft is moveable and runs in a socket bolted on the axle. The axle lever is attached to the shaft by an iron rod. When the horses begin to pull the first thing that happens is the drawing out of the shaft. This pulls

Plate XLVII.

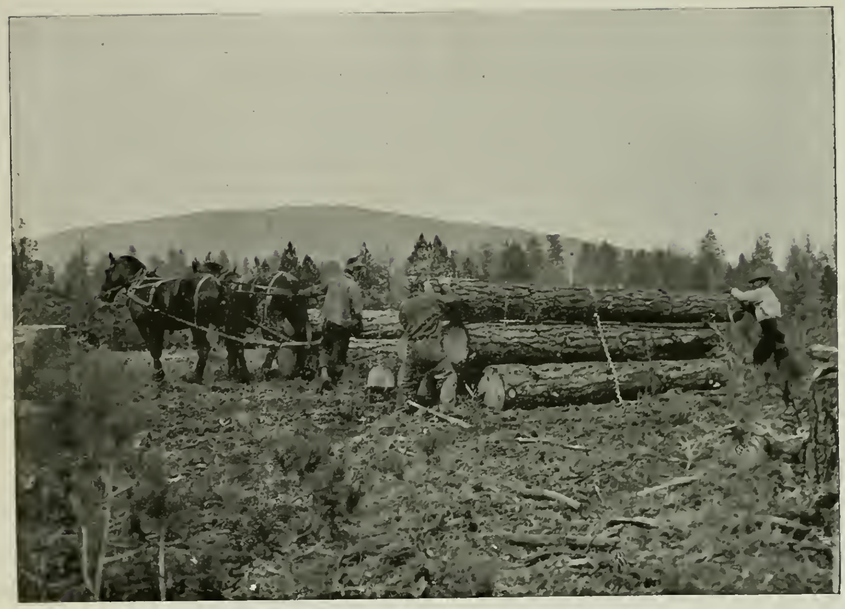


GASOLINE DRAG SAW.

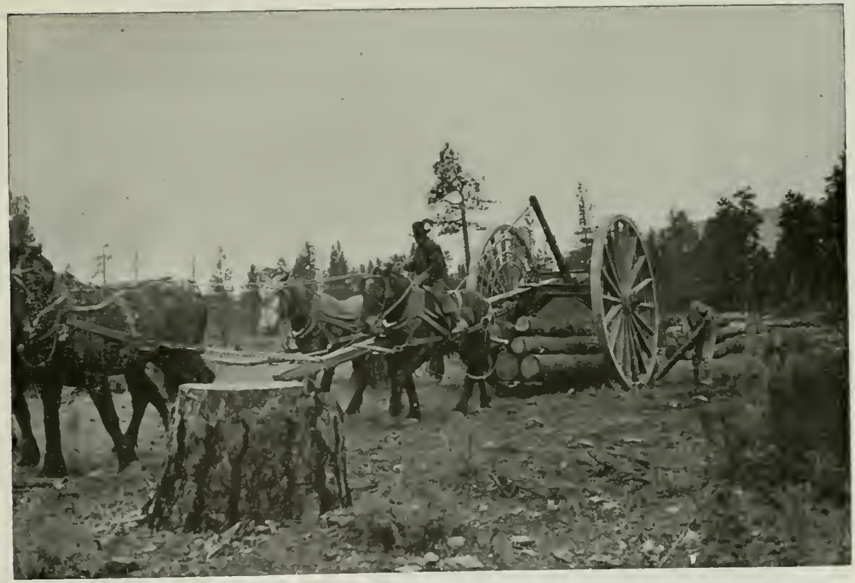
Manufactured by the Vaughan Iron works Co., Portland, Oregon.

(para 74).

BIG WHEELS OF THE SLIP TONGUE TYPE.



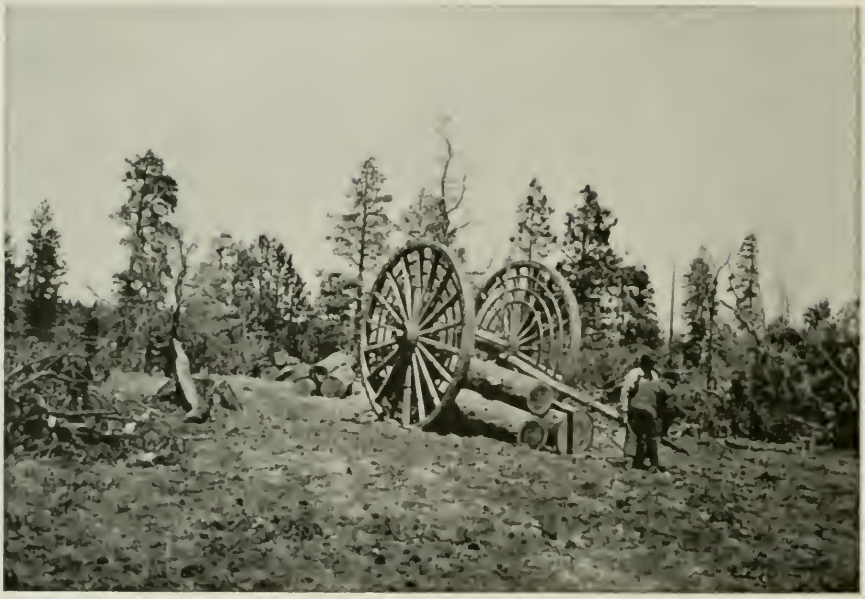
(1). Parbuckling logs into piles for transport by Big Wheels.—Weed, California.



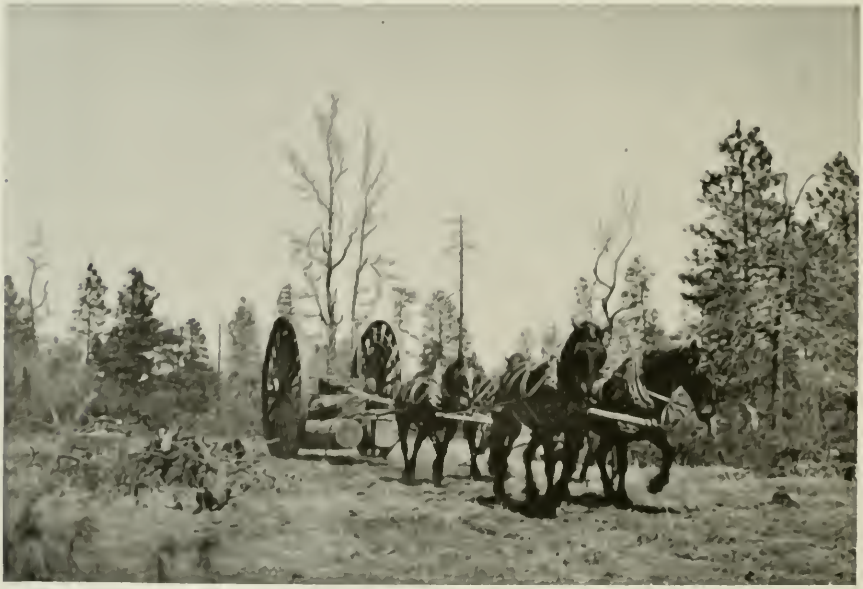
(2). Same as above; Slip Tongue Big Wheels in position ready for hauling.—Weed, California. (para. 79).

Plate XLIX.

BIG WHEELS OF THE FIXED LOAD TYPE.



(1). Axle lever being tied to the logs.—Flagstaff, Arizona.



(2). Same as above: 4 horses hauling 3 tons of logs on fairly level but rough ground.—Flagstaff, Arizona.

down the lever and raises the load. As soon as the pull is checked, the shaft tends to slip back and in doing so to let the lever rise, dropping the load to the ground.

It follows from the above description that any tendency the cart may have to run too fast downhill is automatically checked by the dropping of the load. This is not the case in the other pattern, known as the *Fixed Load Type.*

In this type before hauling begins the horses are harnessed to the axle lever. After they have pulled it down it is tied to the logs. This leaves the load permanently suspended. There is no shaft, the horses are yoked to the front end of the logs.

Messrs. Overpack, Manistee, Michigan are the best known makers of the Big Wheels themselves. The only makers of the Slip Tongue attachment known to the writer are The Redding Iron Works Co., Redding, California.

Caterpillars.

80. A description of hauling appliances would be incomplete without some reference to motor tractors, and especially to the "Caterpillar" type.

The premier firm of manufacturers of the latter is The Holt Manufacturing Co, Illinois and New York.

The writer saw a caterpillar, with sleds instead of front wheels, giving a good account of itself on snow at River Manie, Auebec. The machine was made by The Lombard Auto-Tractor Corporation, New York.

A modification of the above type has appeared in England in the form of caterpillar trucks without motors, for horse or other separate traction. They are said to be successful in the hauling of logs across fields, etc. They sink in less than the horses pulling them.

Although the writer did not himself see much of log transport by motor, yet it is quite correct to state that this method is rapidly developing in North America, and is very likely to take the place of rail transport where conditions are favourable. For a daily output of moderate amount, and in poor and scattered "stands," the road motor possesses obvious advantages.

Perusal of lumber journals month by month is to be recommended for the sake of the copiously illustrated articles and advertisements on the subject that are constantly to be found in them. The number of mnufacturers of road motors specially designed for log transport is large. Sef-loading devices have been on the market for some time.

CHAPTER VI.

FLOATING AND RAFTING OF TIMBER.

81. There is a very good description in "Logging" of the various methods of floating and rafting in use in North America. Perusal of the same is recommended to anyone interested in the subject in India. The following notes are chiefly supplementary.

Ocean rafting.

One of the writer's most remarkable experiences was to see a gigantic log raft, as big as an ocean liner, about to start on a sea voyage of a thousand miles. It is hoped that the notes given below about this, and about another smaller type of sea-going raft, will be useful in solving the problem of exporting timber from Burma to India.

The larger type of raft is built on the Columbia River at Clatskanie, below Portland, Oregon, by The Benson Lumber Co., and the smaller one in the neighbourhood of Prince Rupert, B. C., by the Davis Logging and Trading Co. The Benson rafts have an Ocean journey of 1,000 miles to San Diego California; and the Davis rafts a voyage of 500 miles to Vancouver, B. C., Towing to San Diego takes from 12 to 18 days, and to Vancouver about a week. Bad weather is often encountered. The Benson rafting (construction and towing inclusive) costs about Rs. 6 per ton; The Davis rafting is cheaper, only about Rs. 2 per ton, owing to the simpler method of constructon and the shorter voyage.

An interesting story is told in "Logging" of the first attempt at ocean rafting. About 1884 in Nova Scotia, a large raft was built and started on its voyage to New York. Running short of coal the tug left the raft anchored to an island, whilst it went back to port. On return, the raft was found to have disappeared and after prolonged search it was given up as lost. Several months later the raft turned up intact on the coast of Norway. It was the builder of this raft who started the business later on on the Pacific Coast.

The Benson Lumber Co, who have been building the rafts for over twenty years, claim that they have only lost one out of the last forty four rafts sent out to sea.

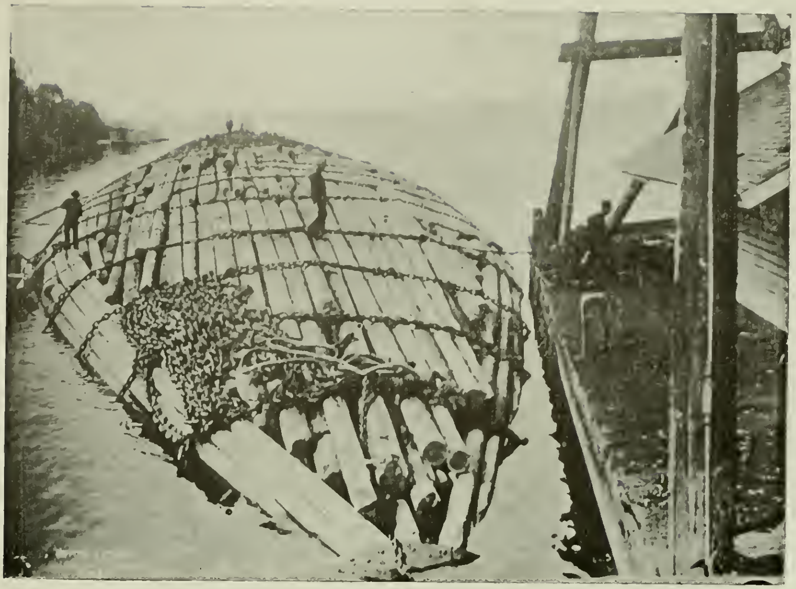
The rafts are from 700 to 1,000 ft. long and contain from 7,000 to 10,000 tons of timber. They draw from 25 to 30 ft. of water. The Davis rafts are a more recent development and are of much smaller size. They are only about 120 ft. long and contain from 1,500 to 2,000 tons of timber. They require a less expensive equipment for construction. The writer saw some Benson rafts being built at Clatskanie, but he was unable to find the time to go and see any Davis rafts.

The following is a short description of the rafts :—

Benson Rafts.

82. (*Vide* "Logging" with a few corrections based on what was seen at Clatskanie).

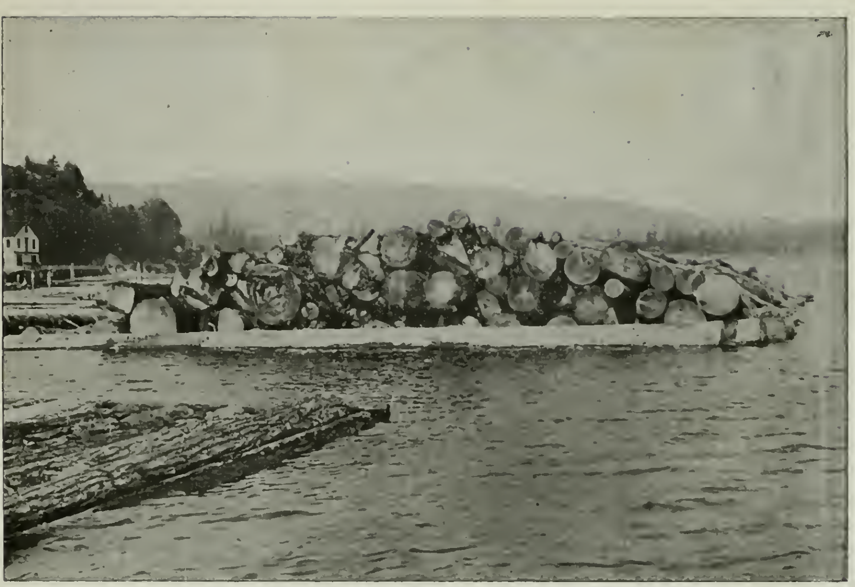
Length : 700 to 1,000 ft. Width : 60 ft. Height : 15 ft. (above water) + 25 feet (below water) = 40 ft.



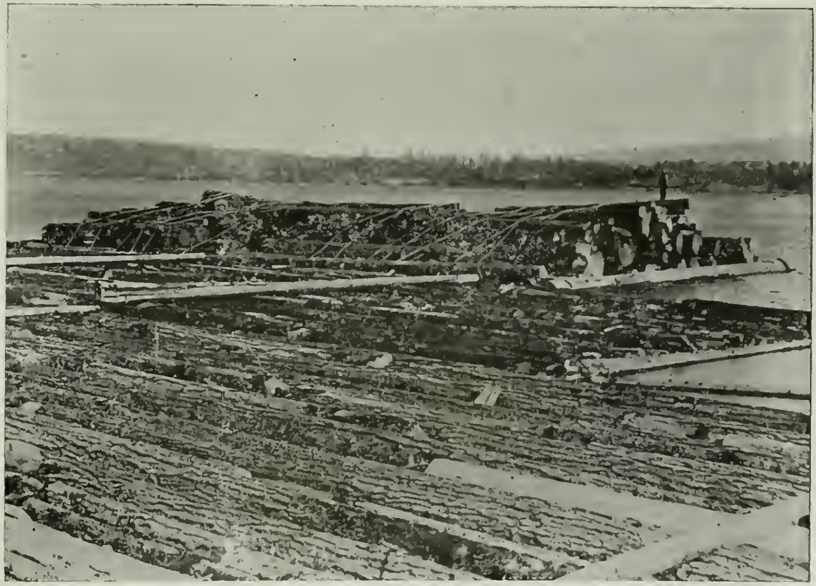
Benson Raft ready for sea, 8000 tons of logs,
Length 1,000 ft.; Beam 60 ft.; Height 40 ft.,
(15 ft. above and 25 ft. below water)
Photo by Gifford and Prentiss, Portland, Oregon.

(2). Benson Raft under construction, showing upper part of cradle.
Photo by Gifford and Prentiss, Portland, Oregon.

(para 81).



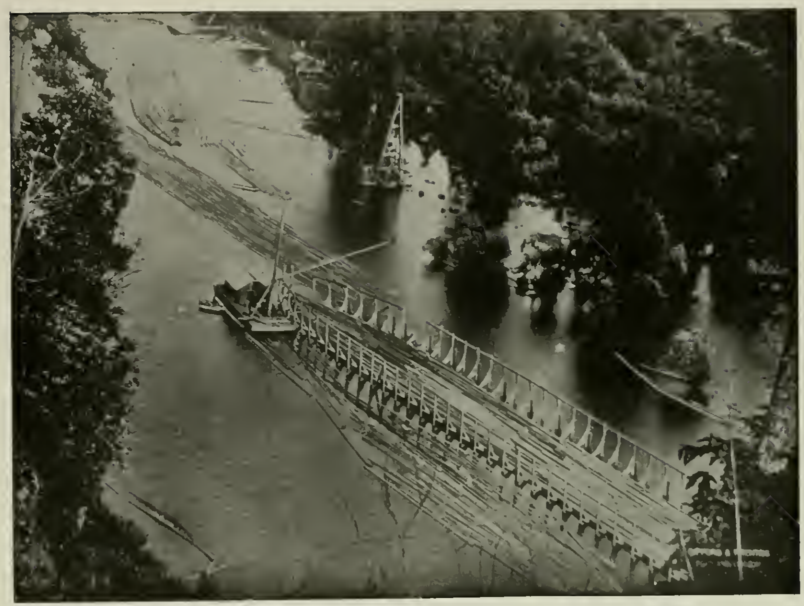
(1).



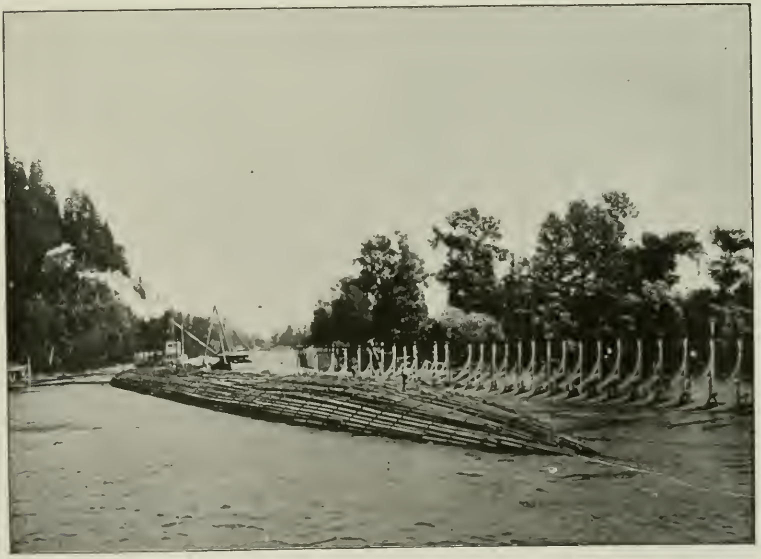
(2). VIEWS OF DAVIS RAFT: 2,000 TONS OF TIMBER.

Commercial Photo. Co., Vancouver, B. C.

(para. 81).



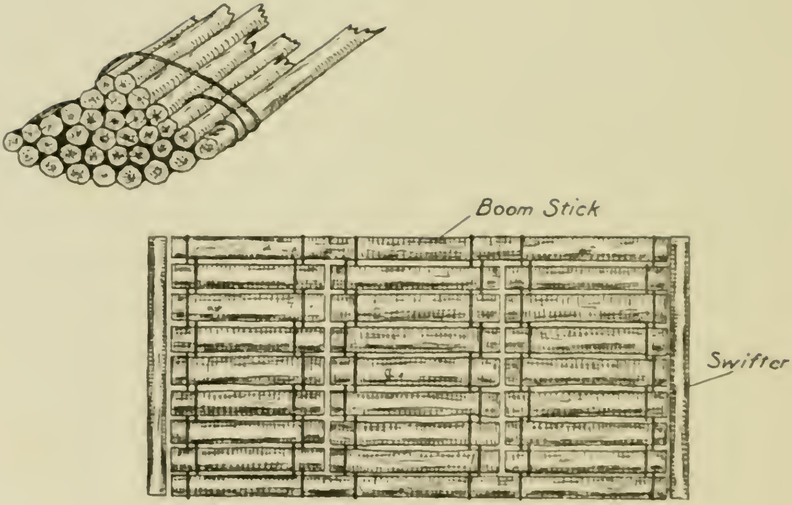
(1). Benson Raft under construction.



(2). Benson Raft completed ; cradle removed.

Photos. by Gifford and Prentiss, Portland, Oregon.

(para. 82).



Davis Raft.

(para 53)

Benson Rafts.

The rafts are cigar shaped, tapering at both ends. A massive sawn timber frame, or " Cradle ", is used for construction. The uprights of the cradle are timbers 24′×20″×12″ braced to the sill beams (30′×20″×12″). The two sides of the cradle are separate and are hinged together in the middle at the inner ends of opposite sill beams. After the raft is finished the hinge keys are pulled out and the two halves of the cradle come apart, leaving the raft floating freely. About 400 tons of timber are used in the construction of the cradle. With minor repairs from time to time it lasts idefinitely.

For piling the logs and hauling the chains a steam derrick mounted on a scow is used. As piling proceeds the cradle is forced down into the water. When piling is about half done a 2¼″ tow chain is laid along the middle of the raft, with 50 ft. hanging down into the water at the front end. Fastened at 12 ft. intervals towards both ends of this chain are seven 1½″ chains, placed " herring-bone" fashion, with their outer ends holding up 1½″ binder chains passed underneath the raft. After piling is finished, the upper ends of the binder chains are drawn together and fastened with shackles.

When afloat the rafts have a tendency to flatten out, thereby increasing the circumference and causing the chains to become tighter. The 850 feet raft seen under construction by the writer was estimated to require 120 tons of chain. 2½″ wire rope is sometimes used, the total weight then being smaller.

The logs are of any lenght up to 60 feet and of any size up to 3 feet in diameter. Quite a number of small logs can be packed inside, as length does not matter much provided that not less than fifty per cent of the logs are 16 feet or more. Crooked logs pack well at the ends.

The long towing rope is fastened to the free end of the 50 feet length of the main chain hanging down in front. The weight of this chain takes up a good deal of the violence of the strains due to wave action.

Davis Rafts.

83. (*Vide* Canadian Lumberman for April 1917 and West Coast Lumberman for December 1917.)

Davis Rafts.

Length—120 feet; Width—70 feet, Height—25 to 30 feet. An elaborately constructed cradle is not used. The first step is to form a floating rectangle (" Boom ") 120′×70′ of long logs tied together (known as " Boom sticks " on the long sides and " Swifters " at the ends.) It is preferable to have single logs of the full length for the sides, although this is not absolutely necessary.

The inside of the boom is evenly packed with a single layer of logs laced to each other at both ends, and also to the boom sticks, with 1¼″ wire rope. On this flooring several layers of logs are piled, highest along the middle. In addition to binding ropes over the top, after the full load of logs has been placed in position, intermediate roping is done as the piling progresses.

It is considered to be essential to have the ends of the raft dressed even and square, and also to make the logs break joint well. Interior spaces are not to be recommended, and the best results are obtained with logs of uniform length.

Rafting from Rangoon to Calcutta.

84. Over half the outturn of Teak timber from the Burma forests goes to India, and wholly in form of squares or scantling sawn in Rangoon or Moulmein. The trade is entirely in the hands of millers in Burma. A certain amount of timber in the log has been shipped to Calcutta on Government account, but freight charges make it impossible to hope for any considerable development in this direction.

Moreover, owing to the War, the supply of ships for any kind of timber will be less than usual for a considerable time, so that rates are bound to remain very high.

The possibility of sending log rafts across the Bay of Bengal is therefore well worth full consideration. If it could be done successfully it would materially help to develop Burma export trade, in general, by freeing shipping; and the Burma timber trade, in particular, by loosening the hold Rangoon firms have over the Indian market.

The rafting need not be limited to teak. For example, from 75,000 to 100,000 metre gauge Pyingado sleepers could be packed inside a mixed Benson raft of some 10,000 tons of timber. A Davis raft of 2,000 tons would probably accommodate 12,000 sleepers. If a large porportion of the sleepers could be cut of double length it would be so much the better.

The writer strongly recommends the Government of India to take the matter up. A start could be made with Davis rafts owing to their simpler method of construction. In British Columbia they cost from 3 to 8 annas per ton to build. The owners of the B. C. patent rights might be asked to send a man to Burma to build a number of the rafts.

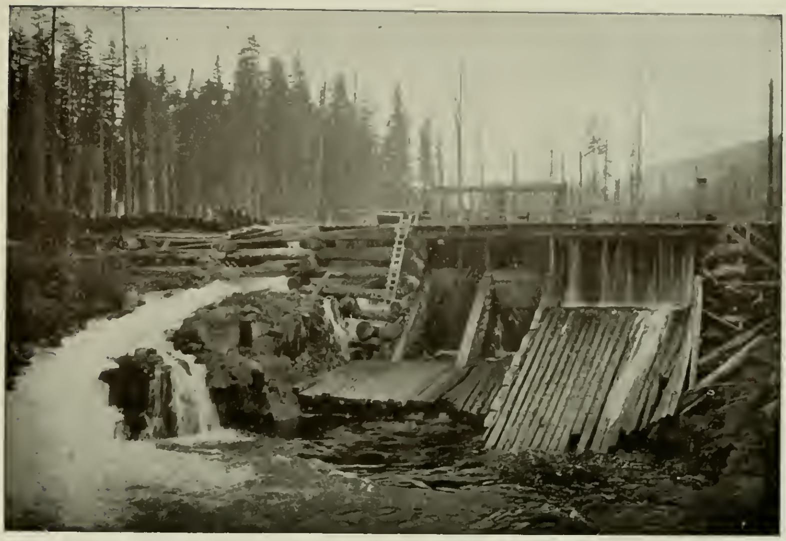
For three months of the year (January to April) good weather for towing could be depended upon. Towing to Calcutta would not take more than ten days or a fortnight.

River driving.

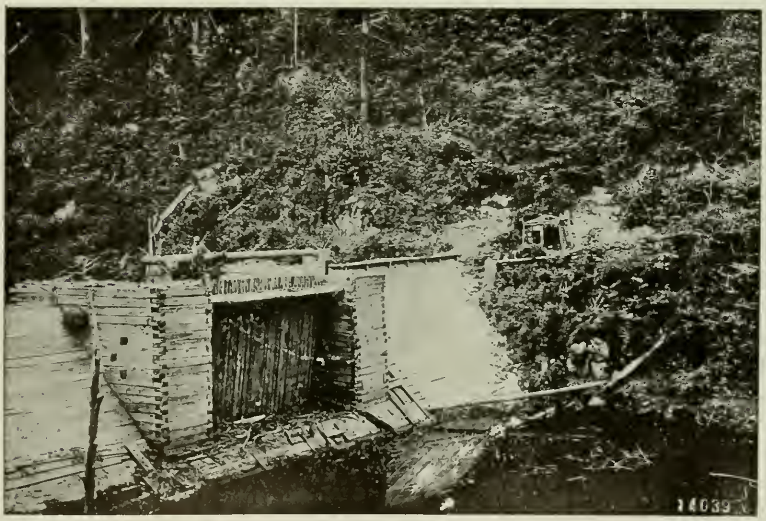
85. The floating of single logs has declined in importance in North America from a variety of causes. Losses in time, as well as in material and value, weigh heavily with the Western lumberman. He cannot help but think of the loss of interest when logs are hung up and do not pass down in one season. Owing to the high price of labour and horses, it would be an expensive business to recover stray logs systematically, so that a large number are lost annually. Mr. Bryant estimates losses from all causes in river driving at anything from 10 to 30 per cent.

In the elephant Burma certainly possesses a decided advantage in respect of floating operations. At the same time the losses in floating teak in Burma are certainly not negligible, and it would be well worth while for the Forest Department to take steps to find out what the losses amount to. Nobody inside the department knows definitely at present.

It is not improbable that the floating of teak logs may to some extent give place to extraction by rail. Assuming that logging railways are installed in a given mixed forest for the extraction of timbers other than teak, the question

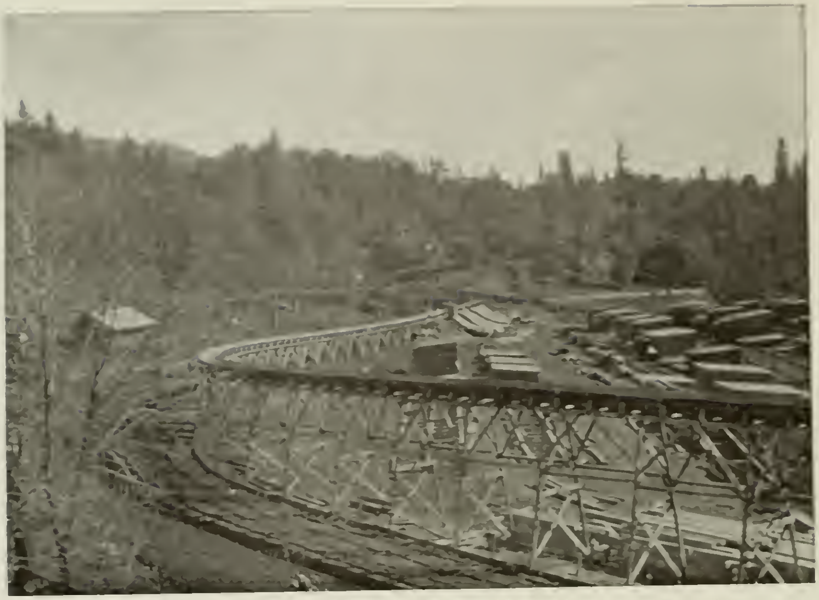


(1). Splash Dam from below.—Wind River, Washington.

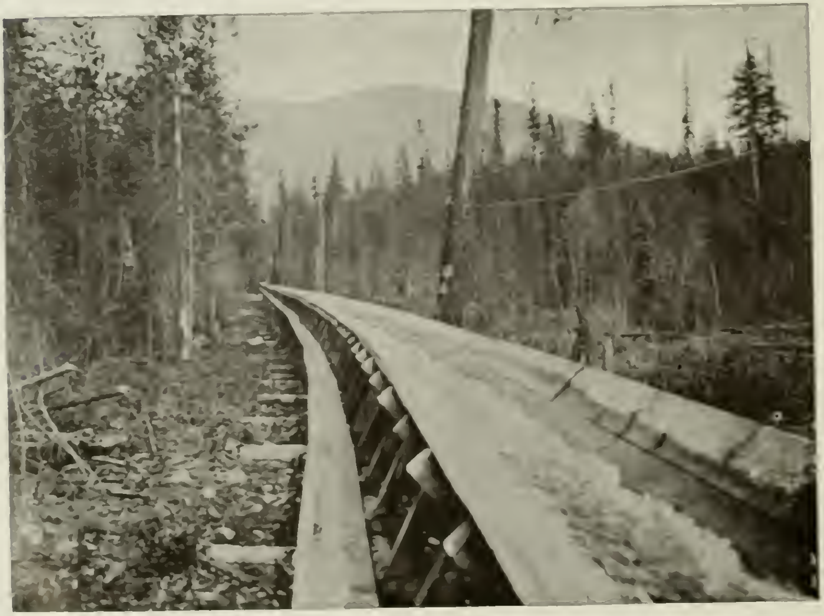


(2). Splash Dam raising water level 35 feet.—Blount County, Tenn.
U. S. Forest Service Photo.

(para 86).



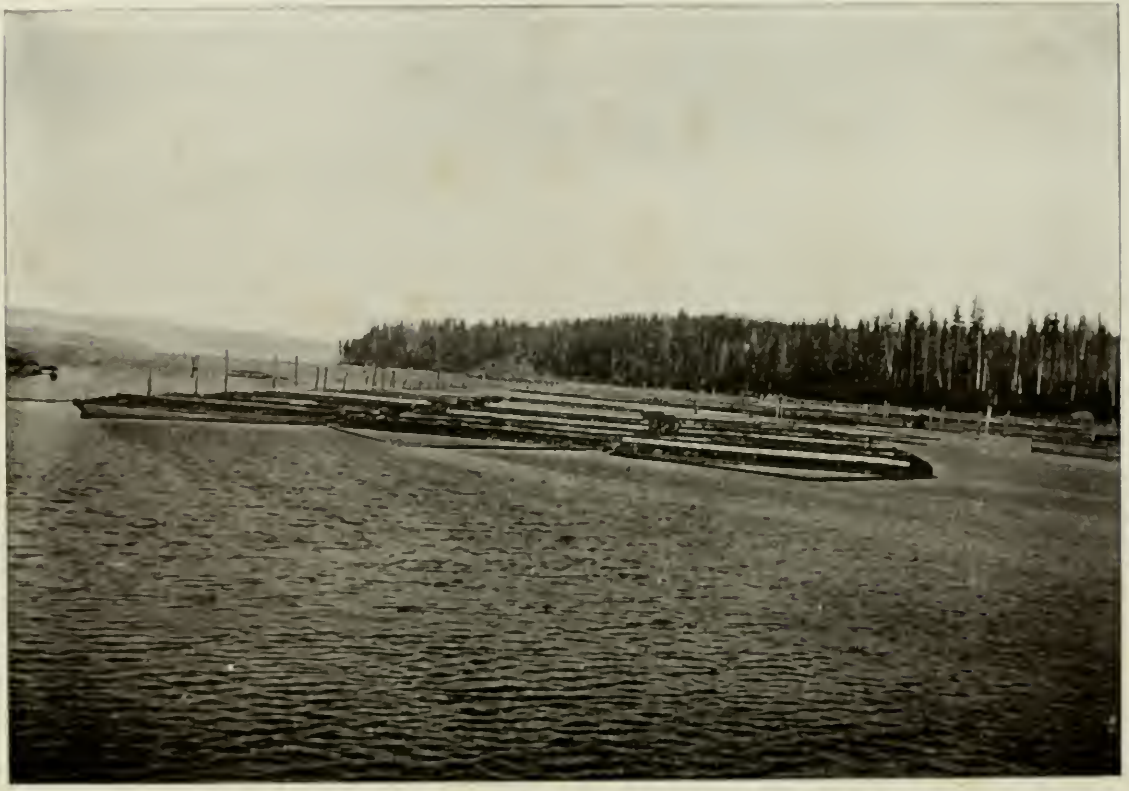
(1). Lower end of a flume bringing sawn timber from Mill to railway.—Lamoine, California.



(2). Flume for logs up to 2 feet in diameter.—Addie, Idaho.

(para 87).

Plate LVI.



ORDINARY TYPE OF RAFT BEING TOWED NEAR VANCOUVER B. C.

(para 88).

may well be asked whether it would not pay to move the teak in the same way, either for the whole or for part of the journey to the mill or sale depôt.

In answering such a question the capital cost of the railway and plant need not be included, unless extra plant is required to cope with the extra traffic. The share of working expenses for railing might well be less than for floating operations. A knowledge of losses would therefore be of use in solving such a problem. It should also be borne in mind that an increase of traffic usually means a decrease in expenses per ton-mile.

Splash Dams.

86. The holding up of water for floating purposes by means of weirs, or "Splash Dams" as they are called, has been well worked out. It is an effective method of getting the most out of a limited supply of water. Construction is simple and within the capacity of ordinary Indian carpenters and woodmen. Before deciding to abandon a stream as hopeless for floating purposes, the use of splash dams is worth considering in its place along with other training works.

Flumes.

87. The use of water flumes for the transport of logs is not so common as for sawn timber. A good example of a log flume was seen at Addie, Idaho. A good example of a flume for sawn timber was seen at Bridal Veil, Oregon, and another at Lamoine, California. In both cases the tract worked by the lumber firm is high up in the mountains, the lowest part being 3,000 feet above the public railway. Sawmills are situated up above in the wooded areas, and the sawn timber is sent down by flume, 5 miles long in one case 10 miles long in the other. It only takes from 15 to 29 minutes for a piece of timber to come down. One drawback to such a method of operation is having to haul all machinery and stores up into the woods by road; a by no means small undertaking as the plant includes several miles of rails, a number of skidding machines and the complete equipment of a large mill.

The description of flumes in "Logging" and also in Bulletin No. 87 of the U. S. Department of Agriculture may usefully be studied by officers interested in the extraction of softwood sleepers in the Himalayas.

River rafting.

88. There is nothing much to remark about ordinary rafting. For want of canes more use is made of chains and staples. Of much the same type is the rafting done in the more sheltered waters between Vancouver, and other islands, and the mainland and on the Columbia River for local mills (*vide* "Logging" page 389). Between two rows of logs tied end to end (and called "Boom Sticks") the logs are packed loosely, without being tied at all. At intervals long poles ("Swifters") are tied across from side to side, on top of the logs, to keep the raft ("Boom") from bulging outwards. Two long logs fastened to the front ends of the boom sticks in the form of a triangle give a place of attachment for the towing rope.

G M. Press, Simla.—No. 231 R.&A.—30-10-19—2,108—A.G., etc.